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AIR QUALITY ASSESSMENT MODEL (AQAM) FIELD DATA COLLECTION GUIDE

Bernard Todd Delaney

Argonne National Laboratory

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Approved for public release; distribution unlimited.

AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
Kirtland Air Force Base, NM 87117

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This technical report has been reviewed and is approved for publication.

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This guide is designed to provide a detailed procedure for obtaining input data for the United States Air Force/Argonne National Laboratory Air Quality Assessment Model (AQAM). AQAM is a computer model developed to assess the impact of Air Force operations on surrounding air quality. The guide describes precisely what data is required, where the data can be obtained, and how the raw data is reduced to usable form. This reduced data is used in AQAM to produce an accurate pollution emission inventory. A section detailing use of

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the gathered data for hand calculations is also included.

PREFACE

In this report every effort has been made to compile as detailed a guide as possible for obtaining operational data concerning sources of air pollution at an active airbase. The accuracy and completeness of source data is of utmost importance because these data determine the quality of the output from AQAM.

This report is one of six closely related published or planned Air Force Weapons Laboratory (AFWL) technical reports which are described as follows:

AFWL-TR-74-54, the Air Quality Assessment Model (AQAM) Operator's Manual, presents methods of coding input data into usable computer format.

AFWL-TR-74-279 details the techniques used to develop the takeoff length equations and climbout angles for most Air Force aircraft.

AFWL-TR-74-303 gives aircraft pollution emission data and landing and takeoff cycle times for Air Force aircraft in common use.

AFWL-TR-74-304 discusses the modeling theory and the methods used.

AFWL-TR-75-220 details procedures and methods by which base level personnel can collect the required raw data to perform a complete air quality analysis on an Air Force base.

The mechanisms of the computer code will be published as a result of the FY 1976 Air Force contract with Argonne National Laboratory.

For their editorial comments and helpful suggestions, E. H. Delaney and Captain Dennis Naugle of OL-AA, AFCEC, have the author's gratitude.

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SECTION I

INTRODUCTION

1. OBJECTIVES

The primary objective of this guide is to present a detailed procedure for acquiring data necessary for the United States Air Force/Argonne National Laboratory Air Quality Assessment Model (AQAM). Some of the same data required for AQAM can also be used in the preparation of Base Environmental Impact Statements. The guide describes what data are required, tells where and in what form the data are likely to be found, and gives methods for reduction of the field data.

A secondary objective of the guide is to present a detailed format for tabulation of the data so it can be used with a minimum of rework directly in the computer model.

A method is presented for use of some of the data in hand calculations (noncomputer aided) to give estimates of the effect of certain emission sources.

2. STRUCTURE

This guide consists of five sections: Introduction, Background Information, Field Data Collection, Procedure for Hand Calculating Emissions, and Procedure for AQAM Data Reduction. The Field Data Collection section is divided into three subsections: Aircraft Sources, Airbase Sources, and Environ Sources (outside the airbase). These subsections are further divided into a number of subheadings. The various subheadings are presented in table 1. The final data reduction sections are a suggested procedure for developing an emission inventory by hand calculation (noncomputer aided) and a procedure for reducing the gathered data into the form acceptable by the computer program AQAM.

The sections and subsections and subdivisions of this guide are ordered to follow almost exactly the required input format of AQAM as detailed in the Argonne National Laboratory report, "A Generalized Air Quality Assessment Model for Air Force Operations - An Operator's Guide."

Table 1

AIR POLLUTION SOURCE SUBHEADINGS

(SECTION III: FIELD DATA COLLECTION)

1. AIRCRAFT SOURCES
   a. Aircraft Flight Operations
   b. Taxiway Paths and Parking Areas
   c. Aircraft Service Vehicles-Aerospace Ground Equipment (AGE)
   d. Fuel Spillage, Vapor Displacement, and Fuel Venting
2. AIRBASE SOURCES
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      (2) Turbine Engine Test Facilities
      (3) Airbase Power Plants
      (4) Air Incinerators
      (5) Storage Tank Point Sources
      (6) Other Point Sources
   b. Area Sources (Stationary)
      (1) Instructions and Procedure for Completing Data Sheet 34
      (2) Hydrocarbon Filling and Working Losses
      (3) Storage Tank Area Sources (Hydrocarbon Breathing and Working Losses)
      (4) Tank-Truck Parking Areas
      (5) Military and Civilian Vehicle Parking Areas (Evaporative Emissions Only)
      (6) Evaporative Hydrocarbons from Other Sources
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3. ENVIRON SOURCES
   a. Environ Point Sources
   b. Environ Area Sources
   c. Environ Line Sources

SECTION II

BACKGROUND INFORMATION

1. BASE BRIEFINGS

Requests for data concerning air pollution or the environment can cause some degree of hesitation from those asked to supply the data. For this reason it is necessary that the Base Commander be fully briefed prior to the initiation of any data gathering. This briefing is possibly the most important of the many briefings that have to be presented throughout the base. If the Base Commander does not believe that the data gathering task is worthy of the time requirements that will be placed on base personnel, obtaining much if any worthwhile information will be difficult. Other necessary briefings are the following:

a. Aircraft
   Each Squadron Commander and or Deputy Commander
   Personnel in charge of Aerospace Ground Equipment (AGE)
   Head of Base Fuels Branch

b. Airbase
   Base Bioenvironmental Engineer
   Base Civil Engineer (chief engineer)
   Base Environmental Coordinator
   Base Transportation Officer
   Base Resident Auditor

c. Environs
   Local Environmental Protection Agency Representative
   Local State Environmental Control Agency
   Local Administrator of the Highway Department

Before any personnel are approached, the appropriate supervisors must be briefed. The officer in charge will generally direct one to the personnel responsible for the needed information. In most instances, the NCOIC (noncommissioned officer in charge) will be extremely helpful because of his knowledge of the basic (nuts-and-bolts) operation of the branch.

One cautionary note--when estimates must be used rather than actual numbers, check these estimates with several knowledgeable sources. In the past, cases have occurred where estimates were extremely inaccurate--usually on the high side.

2. BASE MAPS

Before obtaining any data about the base, acquire from the Base Civil Engineering Office the following maps:

Quantity	Map Description
2	Base Master Plan (Basic Layout Plan)
1	Master Plan (Liquid Fuel System)
1	Vicinity Map
1	Master Plan (Approach Zone Obstructions)

These maps should be scaled 1 inch = 400 feet or 1 inch = 500 feet (except for the Vicinity Map) if possible. The maps are used to obtain the locations of various air pollution sources.

An additional and immediate request of the Base Civil Engineering Office should be that they provide the exact location (latitude, longitude) of a specific point on the base. This location should be accurate to the nearest second. The UTM coordinates of this location can then be obtained from the US Geological Survey Office at the following locations:

WEST of the Mississippi:

US Geological Survey Office
Denver, CO 80225
(303-837-4169)

EAST of the Mississippi:

US Geological Survey Office
Reston, VA
(703-860-6167)

Upon providing the latitude and longitude to these offices, they will supply the corresponding UTM coordinates to the nearest tenth of a meter. The UTM system is an x-y coordinate system with the x axis being east-west and the y-axis being north-south. Distances in the UTM system are measured in meters.

Whenever locations are necessary as data, UTM coordinates must be used. The best method for obtaining these is from the base maps. A mylar grid overlay for each map can be prepared by the Base Civil Engineering drafting office. The grid should be scaled the same as each map, but the grid spacing should be in tenths of kilometers. Use the original UTM coordinates by expanding them on the mylar grid to determine the UTM coordinates of any point.

The UTM coordinate system rather than longitude and latitude is employed in this guide for two major reasons. First, by employing this system, all Air Force bases will have a common grid system and, second, the Environmental Protection Agency (EPA) requires the states to use this coordinate system in the preparation of their State Implementation Plans. This provides a ready source of data for a particular area. At the present time, these data are not very useful, but as the data management system and reporting criteria improve, the usefulness of the data will improve also.

3. ATMOSPHERIC DATA

The vast majority of the required atmospheric data for the operation of AQAM will be supplied by ETAC; therefore, the gathering of atmospheric data is not necessary, except where specific information regarding the effect of atmospheric conditions on a particular operation is needed. Examples are training fires which are limited to a specific set of atmospheric conditions and aircraft which may not use a specific runway under certain wind conditions.

4. AIRCRAFT AND BASE STRENGTH

To make useful comparisons among bases, indicators that are easily obtained and relatively accurate are needed. Many of these indicators are included in data subsections following. However, two specific indicators that should be obtained for use in base-to-base comparisons are the number of each aircraft type assigned to the base and the base strength, broken down by military personnel (enlisted, officers) and civilian personnel.

5. GENERAL INFORMATION

As with any guide of this nature, all points will not be covered. A effort has been made to compile as detailed a guide as possible, but it would be appreciated if any errors or omissions that are uncovered with use are brought to the attention of the originating office of this guide so such errors and omissions may be incorporated into subsequent versions of this guide.

SECTION III

FIELD DATA COLLECTION

1. AIRCRAFT SOURCES

Aircraft data include information on aircraft and on aircraft-associated operations.

a. Aircraft Flight Operations

An aircraft flight operation is a landing or a takeoff. A touch-and-go is counted as a landing and a takeoff, so it is considered two operations. In AQAM the term landing and takeoff cycle (LTO) is used. An LTO consists of a landing and a takeoff or two operations. Since a touch-and-go is two operations, it counts as one LTO.

There are a number of interconnected ways of obtaining information about the number of aircraft operations on a yearly basis at any given airbase. These will be covered in the following pages, and it is suggested that all methods should be used to obtain the most reliable final product.

Begin the data acquisition with the air traffic control office because the personnel responsible for air traffic control at the base must complete an air traffic control operations report (AFCS Form 5, a copy of which is presented as figure 1). This report is a monthly record of the number of official flights by aircraft processed at the airbase. Copies of this form for the past year provide the total number of flight operations that took place at an airbase. By dividing this number by two, the total number of LTOs can be obtained.

The individual entries on this AFCS Form 5 should be discussed with the air control officer to determine the exact procedure used at the base to obtain the operations count.

The numbers from this source will give the total number of operations at the airbase but usually will not supply any additional information. However, at some commands a variety of special records are maintained to help count the number of flights either by squadron or by aircraft tail number. For this reason, query at all levels to locate any additional records or reports that could be helpful in acquiring more specific flight information.

AIR TRAFFIC CONTROL OPERATIONS REPORT	PERIOD OF REPORT	RCS:
TO:	FROM:	
BASE NAME	MAJOR COMMAND	AREA

I. CONTROL TOWER OPERATIONS COUNT

VFR CONTROL TOWER

TIME	MILITARY	CIVILIAN	VFR LOCAL	VFR ITINERANT	IFR A	IFR D	OTHER TRAFFIC	CLEARANCE DELIVERY
0000 - 0600								
0600 - 1200								
1200 - 1800								
1800 - 2400								
SUBTOTALS								
TOTALS								

CONVENTIONAL APPROACH CONTROL TOWER

TIME	MILITARY	CIVILIAN	VFR LOCAL	VFR ITINERANT	IFR A	IFR D	VFR/O	OVERFLIGHTS
0000 - 0600								
0600 - 1200								
1200 - 1800								
1800 - 2400								
SUBTOTALS								
TOTALS								

II. TERMINAL RADAR OPERATIONS COUNT

☐ RAPCON ☐ RAPCC ☐ PAR ☐ GCA

TIME	IFR A	IFR D	VFR/O	OVER-FLIGHTS	RADAR APPROACHES ASR	RADAR APPROACHES PAR	ILS APPROACHES	CLEARANCE DELIVERY
0000 - 0600								
0600 - 1200								
1200 - 1800								
1800 - 2400								
SUBTOTALS								
TOTALS								

III. ENROUTE OPERATIONS COUNT

☐ ARTCC ☐ ACC ☐ RATCC

NUMBER FLIGHT PLANS PROCESSED

	MILITARY	CIVILIAN
ARR & DEP		
OVERFLIGHTS		
SUBTOTALS		
TOTALS		

ATRC

TIME	NUMBER
0000 - 0600	
0600 - 1200	
1200 - 1800	
1800 - 2400	

IV. RSU OPERATIONS

V. VEHICLE COUNT

TIME	NUMBER
0000 - 0600	
0600 - 1200	
1200 - 1800	
1800 - 2400	

AUTHENTICATION

TYPED NAME & GRADE	SIGNATURE

AFCS FORM SEP 75 5 PREVIOUS EDITIONS ARE OBSOLETE.

Figure 1. Air Traffic Control Operations Report

The next step is to obtain a breakdown of touch-and-go LTOs and non-touch-and-go LTOs by aircraft type and their frequency distribution by month, day, and hour. This data can usually be obtained only from the individual squadrons located on the base. Contact the Squadron Commander or the Deputy Commander, explain the data requirements, and he will request those directly involved with flight operations and training to assist. In all cases, it is mandatory to go through the Squadron Commander, although the best information will probably be obtained at a lower administrative level. The information obtained at the squadron level can be double-checked to some extent by interviews with pilots assigned to the unit. The pilot interviews are especially important when determining the number of touch-and-go operations.

The above procedure will, in most instances, supply the required data, but if this method fails, a record of fuel distribution by aircraft type can be obtained from the fuel records branch. These records can also be used as a check on the LTO information. Sometimes this is the only method of obtaining data on transient aircraft (aircraft not assigned to the airbase), but this is not an extremely reliable method because there is no way to determine the average amount of fuel loaded into an aircraft per flight. However, an estimate of the amount loaded into each specific aircraft type per flight can be obtained from personnel in the fuels management branch and/or from the tank-truck drivers. By dividing the total fuel usage for each aircraft type by the average fuel loaded per flight in that specific aircraft type, an estimate of the number of LTO cycles for the time period considered can be calculated. The fuels personnel (especially those assigned to the tank-truck distribution point) can give additional data on the frequency of flights by day of the week and hour of the day.

An additional requirement under aircraft flight operations is runway usage information. These data can be obtained from the flight control tower because a single runway direction is used unless adverse wind conditions prevail and the control tower personnel will know what the specific wind conditions are and their approximate frequency of occurrence. Runway usage limitations for specific aircraft because of runway length requirements or other reasons will have to be obtained from the squadrons, control tower personnel, or pilots. However, wind direction and speed are usually the major controlling factors.

The following pages show the specific data sheets dealing with aircraft flight operations with an explanation of how each should be completed. In a field data-gathering program as outlined here, obtain copies of all raw data sources, then transpose this to the data sheets supplied. Also, the more information obtained the better the final results are likely to be.

The various aircraft types are presented in table 2. These designations should be employed whenever the aircraft type is requested.

(1) Instructions and Procedure for Completing Data Sheet 1: Monthly Distribution of Aircraft LTOs

Data sheet 1 is used to determine the distribution of landings and takeoffs of the various aircraft that use the facilities at the base being surveyed. The normal LTO will consist of the aircraft landing on the runway and its takeoff at some later time. For training flights (touch-and-go), the LTO will be the number of touch-and-go-type operations.

(a) Place in the column headed Aircraft all the types of aircraft assigned to the airbase.

(b) The total number of LTOs by month for each type aircraft assigned to the base is reported on the data sheet.* These monthly values are then totaled and this value placed in the yearly total column.

(c) The number of training touch-and-go LTOs for each aircraft assigned to the base are reported on the same data sheet but are enclosed in parentheses.* These monthly values are then totaled and this value placed in the yearly total column in parentheses.

(2) Instructions and Procedure for Completing Data Sheet 2: Daily Distribution of Aircraft LTOs

Data sheet 2 is used to determine any daily variation in takeoffs and landings.

(a) Enter in the column headed Aircraft all the types of aircraft assigned to the airbase.

---

*If the monthly/daily values are not available for every month/day, indicate on the data sheet the values that are available and estimate those which are not; indicate which figures are estimates.

Table 2

USAF AIRCRAFT INCLUDED IN THE AFWL AIR QUALITY ASSESSMENT PROGRAM

AIRCRAFT	NUMBER AIRCRAFT*	ENGINE TYPE**	ENGINES FOR AIRCRAFT	AFTERBURNER
Bombers				
B-1	N/A	F-101 (GE)	4	Yes
B-52 C-E	268	J-57-19W (P)	8	No
F-G	247	J-57-43WB (P)	8	No
H	99	TF-33-3 (P)	8	No
B-57A-3C	60	J-65 (W)	2	No
E-G	67	TF-33-11 (P)	2	No
Subtotal = 7	= 741			
Fighters				
F-100A-F	734	J-57-21 (P)	1	Yes
F-101 A-H	422	J-57-55 (P)	2	Yes
F-102A	318	J-57-23 (P)	1	Yes
F-104A-G	149	J-79-3B (GE)	1	Yes
F-105B-G	259	J-75-19W (P)	1	Yes
F-106A-B	259	J-75-17 (P)	1	Yes
F-4A-D	1265	J-79-15 (GE)	2	Yes
E	634	J-79-17 (GE)	2	Yes
F-5A-B	24	J-85-13 (GE)	2	Yes
F-111A-F	304	TF-30-9 (P)	2	Yes
F-15	N/A	F-100 (P)	2	Yes
Subtotal = 11	= 4368			
Attack Aircraft				
A-7D	195	TF-41-A-1 (A)	1	No
A-10	N/A	TF-34-2(GE)	2	No
A-37A	[illegible]	J69-25 (Cont)	2	No
B	202	J-85-17A (GE)	2	No
Subtotal = 4	= 421			
Cargo Aircraft				
C-5A	53	TF-39 (GE)	4	No
C-9A	14	JT-8D-9 (P)	2	No
C-130A-S	715	T56-7 (A)	4	No
KC-135A	619	J-57-59W (P)	4	No
B-U	143	TF33-5 (P)	4	No
C-141A	281	TF-33-7 (P)	4	No
C-7	116	R2000	2	No
C-47A-Q	198	R-1830-SIC3-G (P)	2	No
C-97D-L	143	R-4360 (P)	4	No
C-119 G/K	125	R-3350-89BW/J-85	2/4 (plus 2 J-85's in "K" model only)	No
Subtotal = 9	= 2407			
Training Aircraft				
T-29	333	R-2800-99 (P)		NO
T-33A-B	882	J33-35 (A)	1	No
T-37B	817	J69-125 (C)	2	No
T-38	1053	J85-5 (GE)	2	Yes
T-39A-F	141	J60-3A (P)	2	No
T-41A-C	240	O-300(C)	1	NO
Subtotal = 5	= 3481			
Observation Aircraft				
O-1A		0470 (C)	1	No
O-2A,B	394	10360D (C)	2	No
OV-10A	110	T-76	2	No
Subtotal = 3	= 516			
Helicopters				
HH-3	94	T58-5 (GE)	1	No
HH-43B-F	149	T53-1 (L)	1	No
HH-53BC	57	T64-7 (GE)	2	No
UH-1F	69	T58-3 (GE)	1	No
N,H,P	127	T53-13 (L)	1	No
Subtotal = 5	= 496			
TOTALS				
45 Aircraft types	12,410 Aircraft	8 Turbojets 8 Turbofans 5 Turboprops 8 Pistons 29 Basic Engine Models		7 Afterburning Engines

* The number of aircraft per model was compiled from the AFLC prepared Aerospace Vehicle Inventory report dated 21 March 1972 which was declassified on 21 March 1973.

** Engine Manufacturers Code: GE - General Electric; P - Pratt & Whitney Aircraft; A - Allison; C - Continental; G - Garrett Air Research; L - Lycoming.

MONTHLY DISTRIBUTION OF AIRCRAFT LTO'S

Data Sheet 1

Aircraft	July	August	September	October	November	December	January	February	March	April	May	June	Yearly Total

Data Sheet 2

DAILY DISTRIBUTION OF AIRCRAFT LTO'S

Aircraft Type	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday

(b) Record the total number of LTOs by day (for an average week) for each aircraft type.*

(c) Record on the data sheet the number of training (touch-and-go) LTOs for each aircraft type by enclosing the value in parentheses.*

(3) Instructions and Procedure for Completing Data Sheet 3: Hourly Distribution of Takeoffs

Data sheet 3 is used to determine any significant hourly pattern in the takeoffs of the various aircraft in the base inventory. Fill out one data sheet for an average weekday and one for an average weekend day.

(a) Circle at top of data sheet whether it is filled out for an average weekday or for an average weekend day.

(b) Place in the column headed Aircraft all the types of aircraft assigned to the airbase.

(c) Record by hour of the day the number of takeoffs for each aircraft type during an average weekday and during an average weekend day.*

(d) In parentheses record by hour of the day the number of training flight takeoffs for each aircraft type for an average weekday and for an average weekend day.*

(4) Instructions and Procedure for Completing Data Sheet 4: Hourly Distribution of Landings

Data sheet 4 is used to determine any significant hourly pattern in the landings of the various aircraft in the base inventory. Fill out one data sheet for an average weekday and one for an average weekend day.

(a) Circle at top of data sheet whether it is filled out for an average weekday or for an average weekend day.

(b) Place in the column headed aircraft all the types of aircraft assigned to the airbase.

---

*If the number of takeoffs for each aircraft type for each hour of the average weekday and average weekend day are not available, indicate the values that are available and estimate those which are not; indicate those which are estimates.

Data Sheet 3

HOURLY TAKEOFFS
AVERAGE WEEKDAY/AVERAGE WEEKEND DAY
(Circle Appropriate Title)

Aircraft	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400

Data Sheet 4

HOURLY LANDINGS

AVERAGE WEEK DAY/AVERAGE WEEKEND DAY
(Circle Appropriate Title)

Aircraft	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400

(c) Record by hour of the day the number of landings for each aircraft during an average weekday and during an average weekend day.*

(d) In parentheses record by hour of the day the number of training flight landings for each aircraft for an average weekday and for an average weekend day.*

(5) Instructions and Procedure for Completing Data Sheet 5: Runway Data

Data sheet 5 is used to obtain physical information about the various runways that exist at an Air Force base.

It is important that the method of recording physical information on the runways be clearly understood before any data is recorded. For this reason the following paragraph explaining the required data for runways has been extracted from the AQAM users manual prepared by Argonne National Laboratory.

> As certain conventions are assumed concerning runways, it is necessary that these be clearly understood. A runway is considered to be a vector quantity. That is, it has both a length and a direction. Thus, if aircraft land and takeoff on a physical strip of pavement in both directions, this strip of pavement constitutes <u>two</u> runways, both of the same length, but of opposite direction. As an example, the physical strip of pavement of length "L," pictured in figure 1 (see figure 2 in this guide), would be considered as two runways depending on the direction in which arriving and departing aircraft are using it, as pictured in "b" and "c." The arrows are drawn in the direction in which the aircraft are traveling. Runway b is specified by L, θ_2, X_2, Y_2, while Runway c is specified by L, θ_3, X_3, Y_3. Where θ is the angle measured clockwise from true N (north), X and Y are the UTM coordinates of the runway (arrow) tail. The X and Y are the coordinates of the point where the runway roll starts for departing aircraft, which are the same as the touchdown coordinates for arriving or inbound aircraft.

(a) Enter airbase designation for each runway.

(b) Enter the length, width, orientation, and the beginning and ending coordinates of each runway in the proper column.

---

*If the number of landings for each aircraft type for each hour of the average day are not available, estimate those which are not; indicate those which are estimates.

DATA SHEET 5

RUNWAY DATA

1. Runway designation ________ ________ ________ ________ ________ ________
2. Length (M) ________ ________ ________ ________ ________ ________
3. Width (M) ________ ________ ________ ________ ________ ________
4. Orientation (O) ________ ________ ________ ________ ________ ________
5. X,Y Coordinate one end (UTM) ____
6. X,Y Coordinate other end (UTM) ____
7. Percentage use by aircraft type (enter each aircraft type below) ________ ________ ________ ________ ________ ________

________ ________ ________ ________ ________ ________ ________

________ ________ ________ ________ ________ ________ ________

________ ________ ________ ________ ________ ________ ________

________ ________ ________ ________ ________ ________ ________

________ ________ ________ ________ ________ ________ ________

8. Limitations on use of any of the above runways:*

   (a) Runway________________

   (b) Runway________________

   (c) Runway________________

*Use a separate sheet of paper for any explanations that might be required.

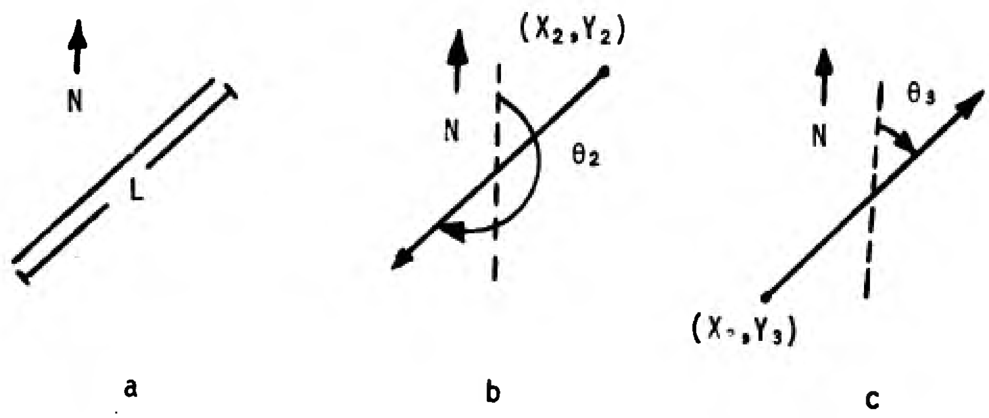

Figure 2. Runway Description

(c) Enter each aircraft type. Enter across the percent of each aircraft type's total use which occurs on each runway. This row should sum to 100 percent. (This percent is usually the same on each runway for all aircraft types unless the runway has certain limitations.)

(6) Instructions and Procedures for Completing Data Sheet 6: Pilot Survey

Data sheet 6 is used to obtain qualitative information about the general operation of aircraft within the Air Force inventory at a specific base. This data will be used in conjunction with the LTO algorithm to compute and/or check the LTO cycle for each aircraft type.

In the AQAM model the term LTO cycle is often used in conjunction with the term operations. The LTO cycle is defined as all normal operational modes performed by an aircraft between the time it descends below an altitude of 3000 feet through landing and after takeoff until the 3000-foot altitude is again attained. The LTO cycle includes nine operational modes (1 through 9) and one training mode (10):

(1) Idle at start up

(2) Taxi before takeoff

(3) Engine takeoff

(4) Runway roll

(5)a Climbout number 1
b Climbout number 2

(6)a Approach number 1
b Approach number 2

DATA SHEET 6

PILOT SURVEY

AIRCRAFT TYPE ____________

COMMAND BASE ____________

AIRCRAFT MODE	ENGINE MODE (LBS FUEL/HR)	TIME* (MIN)	DISTANCE** (FT)	SPEED*** (MIN)	ADDITIONAL DATA
1. IDLE AT START UP					
2. TAXI BEFORE TAKE-OFF					
3. ENGINE CHECK AT RUNWAY END					
4. RUNWAY ROLL					AVG TAKE-OFF WEIGHT ______
5a. CLIMBOUT-STEP #1					STEP #1 HEIGHT ______ AVG CLIMB ANGLE ______
b. CLIMBOUT TO AGL-STEP #2					AVG CLIMB ANGLE ______
6a. APPROACH FROM 3000' AGL-STEP #1					AVG DECENT ANGLE ______
b. APPROACH FROM-STEP #2					STEP #2 HEIGHT ______ AVG DECENT ANGLE ______
7. LANDING ON RUNWAY					DRAG CHUTE: YES ___ NO ___ % OF TIME USED ______
8. TAXI AFTER LANDING					
9. IDLE AT SHUTDOWN					
10. TOUCH & GO OPERATIONS			(ON RUNWAY)		

11. AMOUNT OF FUEL LOST (SPILLED, VENTED, PURGED) DURING FOLLOWING OPERATION

A. REFUELING ______ C. TAXI ______ E. ENGINE SHUT-DOWN ______

B. ENGINE START-UP ______ D. TAKE-OFF ______ F. OTHER ______

*ROUND-OFF TIME IN MODE TO THE NEAREST 0.1 MINUTES

**DISTANCE HORIZONTAL COMPONENT ONLY

***SPEED AS INDICATED IN ATTACHED FIGURE: $\bar{V}$-AVG SPEED, V-INSTANTANEOUS SPEED

(7) Landing on runway

(8) Taxi after landing

(9) Idle at shutdown

(10) Touch and go

The first nine modes are depicted in figure 3.

(a) A data sheet should be filled out for each aircraft type in the base inventory.

(b) Fill out for each mode the applicable sets of data indicated.

(c) Engine fuel flow rate is to be given in pounds of fuel used per hour (average) for operation of the engine in the specified mode.

(d) Time is the average duration of the particular engine mode.

(e) Distance is the average distance traveled.

(f) Speed refers to the speed of the aircraft. The footnote on the data sheet gives particulars about the specific speed requested.

(g) Answer as concisely as possible the questions listed under Additional Data, but if a single best number is not available, indicate a common range.

(h) Give average values in gallons for question 11.

(i) Indicate units beside the numerical answers.

(7) Instructions and Procedures for Completing Data Sheets 7 and 8: Aircraft Operational Information I, II

Data sheets 7 and 8 are to be completed from the pilot survey sheets (data sheet 6) and any other sources of information that may become available during the course of conducting the study. This additional information, if any, should be so indicated.

(a) Enter each aircraft type in the base inventory under the heading Aircraft.

(b) For each aircraft type compute average values for each of the remaining headings from the individual pilot survey sheets.

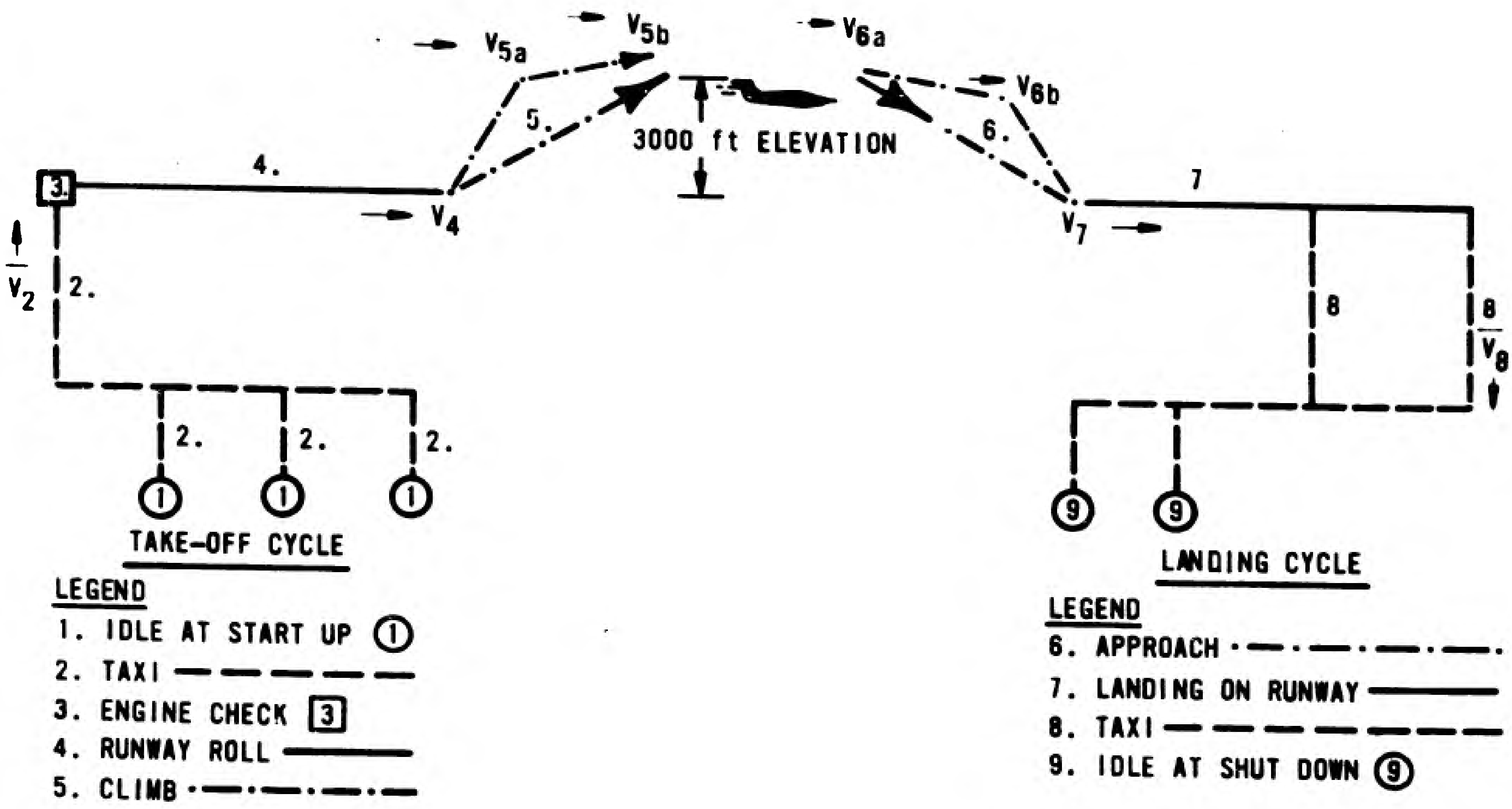

Figure 3. Landing and Takeoff Cycles

AIRCRAFT OPERATIONAL INFORMATION I

Data Sheet 7

Aircraft	Operation											
	Time (min) for LTO Cycle											
	Idle at Start up	Taxi before Take Off	Engine Check	Runway Roll	Climbout #1	Climbout #2	Approach #1	Approach #2	Landing on Runway	Taxi After Landing	Idle at Shutdown	Touch and Go

Data Sheet 8

AIRCRAFT OPERATIONAL INFORMATION II

Aircraft	Operation								
	Additional LTO Data								
	Climb Angle	Descent Angle	Drag Chute	Average Speeds			Altitude for Afterburner Shut-Off	Average Weights	
				Taxi	Take Off	Landing		Take Off	Landing

b. Taxiway Paths and Parking Areas

Record data on taxiway paths and parking areas directly on a map of the base (preferably on a map with a scale of 1 inch = 400 feet or 1 inch = 500 feet). A map of the base is needed which includes the ends of the runways, all parking ramps, taxiways, and holding areas. This map should have previously been obtained from the Base Civil Engineering Office and all locations will be by UTM coordinates as explained previously.

Detailed information is needed on how each type of aircraft proceeds from its assigned parking area to the end of the takeoff runway and how an aircraft on landing proceeds from the runway to its designated parking area.

The first step is to determine where the parking areas are for each of the assigned aircraft types and for transient aircraft. This cannot be just an approximate location and will require the drawing of the parking areas on the base map with reasonable detail. Indicate on the map the type of aircraft in each parking area and parking area capacity. This makes it possible at some later time to determine number and types of aircraft and their location.

One source for obtaining these data is the individual squadrons for the assigned aircraft and the transient alert area for transient aircraft. Another possible source is control tower personnel.

After obtaining the parking area information, determine and indicate on the base map how the aircraft from each parking area proceeds to and from the runway ends. This data can be obtained by observations of taxiing aircraft, from discussion with tower personnel, and from discussion with individual pilots. It should be noted that the taxiways are not necessarily always the shortest distance between the parking area and the runway end. For example, fighter aircraft are required to go to arming or dearming areas when they are carrying live weapons. Also, some cargo aircraft can only use specific taxiway paths because of their size and/or weight.

After the information has been gathered in rough form on the base map, it must be processed and placed on the data sheets provided. The procedure for completing this task and the required data sheets follow.

(1) Instructions and Procedure for Completing Data Sheet 9: Aircraft Parking Areas I

This data sheet consists of a base map for describing the aircraft parking areas.

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(Data sheet 9 will be a map of base)

(a) Draw in an area on the base map that reasonably represents the parking areas for the various types of aircraft in the base inventory and in the transient aircraft parking areas.

(b) Assign a letter to each parking area and indicate the type and number of aircraft in each area. Record this on the map.

(2) Instructions and Procedure for Completing Data Sheet 10: Aircraft Parking Areas II

Data sheet 10 is used to determine the location of the usual parking and engine-start areas on the base.

(a) This data sheet should be completed using the base map that describes the parking areas (data sheet 9).

(b) Enter each aircraft type in the base inventory.

(c) Fill out the data sheet for each parking area and engine-start area used by a type of aircraft.

(d) Record the letter code of each parking area as previously assigned (data sheet 9).

(e) For each aircraft type record the percent of that type's total parking which occurs in each parking area.

(f) If the engine-start area and the parking area are different areas and if the aircraft has to be towed to the start area, the same letter code should be assigned to the two areas. If the engine-start area and the parking area are the same, record nothing in the engine-start column.

(3) Instructions and Procedure for Completing Data Sheet 11: Taxiway Information I

This data sheet consists of a base map for describing the taxiway paths.

(a) On the base map draw the taxiways used to go from (to) the end of each runway to (from) the appropriate parking areas for each type of aircraft.

(b) Assign a unique two-digit number to each taxiway and enter the taxiway number on the map.

DATA SHEET 10

AIRCRAFT PARKING AREAS II

AIRCRAFT TYPE	PARKING AREAS						ENGINE START AREAS			
	LETTER CODE	% OF TOTAL PARKING	LETTER CODE	% OF TOTAL PARKING	LETTER CODE	% OF TOTAL PARKING	LETTER CODE	% OF TOTAL PARKING	LETTER CODE	% OF TOTAL PARKING

This page intentionally left blank.

(Data sheet 11 will be a map of base)

(4) Instructions and Procedure for Completing Data Sheet 12: Taxiway Information II

Data sheet 12 will be used to obtain physical information about the taxiways that exist at the surveyed Air Force base. This data sheet should be completed twice, once for inbound taxiways (runway to parking area) and once for outbound taxiways (parking area to runway).

(a) Enter the taxiway number or designation from data sheet 11.

(b) Enter beginning and ending coordinates of the numerically designated taxiways in the proper columns. This should consist of the UTM coordinates for the end of the runway and the parking area.

(c) Discuss any limitation on the use of the taxiways presented as to type of aircraft that cannot use them and the reason why the taxiways cannot be used by these types of aircraft.

c. Aircraft Service Vehicles-Aerospace Ground Equipment (AGE)

Auxiliary ground equipment as used in this guide are those pieces of ground equipment used in association with aircraft operations. This equipment will be considered under separate areas as follows: equipment used for routine maintenance, nonroutine maintenance, aircraft loading and unloading, and equipment associated with the LTO aircraft cycle. Specific AGE that will be considered under each of these major categories can be found in table 3.

Table 3

AEROSPACE GROUND EQUIPMENT

Routine maintenance	Nonroutine maintenance	Aircraft loading/unloading	Aircraft LTO specific cycle
Compressors	Compressors	Fork lifts	Fuel trucks
Heaters	Heaters	Hydraulic test stands	Engine starters
Coolers	Coolers	Belt loaders	Tow trucks
Generators	Generators	Other	De-icers
Light carts	Light carts		Other
Turbine AGE	Turbine AGE		
	Hydraulic test stands		
	Specialized		

DATE SHEET 12

TAXIWAY DATA

1. Taxiway number __________ __________ __________ __________
2. X,Y Coordinate one end ______ ______ ______ ______ ______ ______ ______ ______
3. X,Y Coordinate other end ______ ______ ______ ______ ______ ______ ______ ______
4. Limitations on use of any of the above taxiways:

   a. Taxiway__________

   b. Taxiway__________

   c. Taxiway__________

   d. Taxiway__________

The primary variable of interest for AGE is the amount of running time spent by each piece of equipment in servicing or assisting the aircraft. This time factor in conjunction with the emission factor gives an emission that can be associated with the type of aircraft being serviced. This value can then be used to assist in the determination of the total emissions associated with the aircraft.

To obtain the running time of AGE, two sets of data for cross checking are necessary. One is the fuel usage by AGE which is available from the fuels management branch. This consists of gallons of JP-4, gas, and diesel fuel purchased by the various AGE shops. The second is the number of hours of operation that AGE is used for preparation of an aircraft for flight and for postflight operation.

Total hours of engine operation for some pieces of AGE are recorded, but this data does not exist for every type of AGE at an airbase.

If there are no records, the best method is to present and explain data sheets 13 through 17 to all crew chiefs and maintenance chiefs to get their estimate of AGE usage for aircraft flight preparation and repair. By following this procedure a better idea is obtained of the distribution of AGE between the various aircraft types, thus providing a better spatial resolution of pollution sources.

If the above method cannot be used, usually the NCOIC of the AGE facility can give a fairly good estimate of the pieces of AGE that are operated on a daily basis, the number of hours they operate, and also the quantity of each type. This information will give the total hours of operation for AGE, which can then be divided proportionately among the various aircraft types.

At some bases the information concerning the hours of operation may not be available. In this case, one would have to rely on the amount of fuel used, which can be obtained from the fuels management branch (data sheet 36). This figure (number of gallons) would have to be converted to number of hours by an appropriate conversion factor based on fuel usage of the various types of AGE. This is done in the final data reduction section.

Data sheets 13 through 15 are the basic sheets for obtaining raw information that will be refined for use on data sheets 18 through 20. Data sheets 13 through 15 are the same form, so the proper number and title must be circled.

(1) Instructions and Procedure for Completing Data Sheet 13: Routine Maintenance

Data sheet 13 deals with routine maintenance.

(a) Circle the number 13 and the title, Routine Maintenance.

(b) Fill out a form for every aircraft type in the base inventory.

(c) Enter the designation of the aircraft type for which the form is being completed.

(d) The numerals 1 through 10 on data sheet 13 refer to the following 10 maintenance operations that are performed:

1. Preflight inspection
2. Engine start
3. Oil servicing
4. Refueling
5. Other __________(specify)
6. Other __________(specify)
7. Other __________(specify)
8. Other __________(specify)
9. Other __________(specify)
10. Basic postflight inspection

(e) Enter the frequency of operations. For example, oil servicing could occur on an average of once in three flights. This fact should be indicated in the space under operation 1 as 1/3 which indicated that this operation is performed once in three flights.

(f) AGE are listed on the left-hand side of data sheet 13. Under Average Time in Use, enter the average amount of time in minutes that the specific piece of equipment is used for each of the numbered maintenance operations. Additional equipment that is used and not specified by name on data sheet 13 should be entered under the appropriate heading.

(2) Instructions and Procedure for Completing Data Sheet 14: Nonroutine Maintenance

Data sheet 14 deals with nonroutine maintenance.

(a) Circle the number 14 and the title, Nonroutine Maintenance.

(b) Fill out a form for every aircraft type in the base inventory.

(c) Enter the designation of the aircraft type for which the form is being completed.

(d) The numerals 1 through 10 on data sheet 14 refer to the following 10 maintenance operations that are performed:

1. Fuel tank reconfiguration
2. Brake and tire change
3. Navigation and avionics
4. Field maintenance structural repair
5. Field maintenance corrosion control
6. Field maintenance hydraulic repair
7. Aircraft electrical repair
8. Other __________(specify)
9. Other __________(specify)
10. Other __________(specify)

(e) Enter frequency of operations. For example, brake and tire change may occur once in 20 flights; this fact should be indicated in the space under operation 2 as 1/20.

(f) AGE is listed on the left-hand side of data sheet 14. Under Average Time in Use, enter the average amount of time in <u>minutes</u> that the specific piece of equipment is used for each of the numbered maintenance operations. Additional equipment that is used and not specified by name on data sheet 14 should be entered under the appropriate heading.

(3) Instructions and Procedure for Completing Data Sheet 15: Weapons Loading and Other

Data sheet 15 deals with weapon systems operation.

(a) Circle the number 15 and the title, Weapons Loading.

(b) Fill out a form for every aircraft type in the base inventory.

(c) Enter the designation of the aircraft type for which the form is being completed.

(d) The numerals 1 through 10 on data sheet 15 refer to the following 10 maintenance operations that are performed on fighter, bomber, attack, and reconnaissance aircraft:

Data Sheet 13/14/15

AIRCRAFT GROUND EQUIPMENT USAGE

Routine/Non-Routine/Weapons Loading

Aircraft Type ______________

Equipment	Maintenance Operation*									
	1	2	3	4	5	6	7	8	9	10
	Frequency of Operation									
	Average Time in Use									
COMPRESSOR:										
MA-1A Gas Turbine Compressor (JP-4)										
MC-1A Air Compressor ("High Pack")										
MC-2A Air Compressor ("Low Pack")										
Other: (specify)										
GENERATORS:										
AM32A-60 Gas Turbine Generator (JP-4)										
AM32A-60A Gas Turbine Generator (JP-4)										
MD-3 Generator Set (C-26)										
M-32A-10 Generator (Gas)										
Other: (specify)										
HEATERS:										
BT-400 (H-1) Heater										
Other: (specify)										

COOLERS:										
M32 Air Cooler										
TEST STANDS:										
TTU-228E Hydraulic Test Stand										
MJ-2A										
MK-3 + 3a (electric)										
D-5										
D-6 + 6a (electric)										
LIGHT CARTS:										
NF-2 Light Cart										
OTHER AGE EQUIPMENT NOT COVERED ABOVE:										
Towing Tugs										
SPECIALIZED OPERATIONAL EQUIPMENT:										
MJ-1 Bomb Lift										
MJ-4 Bomb Lift										

*See listing of Maintenance Operations on the previous page.

1. Weapons loading routine (specific operations)
2. Weapons loading nonroutine
3. Weapons release systems functional check
4. Tactical situation maintenance
5. Photo pod maintenance
6. Other __________(specify)
7. Other __________(specify)
8. Other __________(specify)
9. Other __________(specify)
10. Other __________(specify)

(e) Enter frequency of operations. For example, weapons loading routine may occur one in five flights; this fact should be indicated in the space under operation 1 as 1/5.

(f) AGE are listed on the left-hand side of data sheet 15. Under Average Time in Use, enter the average amount of time in minutes that the specific piece of equipment is used for each of the numbered maintenance operations. Additional equipment that is used and not specified by name on data sheet 15 should be entered under the appropriate heading.

(4) Instructions and Procedure for Completing Data Sheet 16: Cargo Aircraft Operations

Data sheet 16 is used to obtain information about the equipment used and the time that the equipment is used for loading and unloading the various cargo aircraft within the US Air Force inventory.

(a) Fill out a data sheet for each cargo type of aircraft in the base inventory.

(b) Under Average Time, give the approximate amount of time used to load or unload an aircraft.

(c) Specify by Air Force designation the equipment commonly used for loading and unloading. Quantity refers to the number of these vehicles operating during the loading or unloading time period; Percent refers to the approximate percentage of this time that they are involved. An example of data for this sheet follows:

USAF designation	Quantity/% of time used
Belt loader	1 / 95%
Fork lift	2 / 25%

Data Sheet 16

CARGO AIRCRAFT OPERATIONS

Aircraft Type____________________

Average Time for Loading ____________		Average Time for Unloading ____________	
Equipment Used for Loading	% of Total Loading Time Equipment in Use	Equipment Used for Unloading	% of Total Unloading Time Equipment in Use

The example shows that a belt loader was operated for 95 percent of the average time required to load (unload) the plane and that two fork-lift trucks were also employed for approximately 25 percent of the average time.

(5) Instructions and Procedure for Completing Data Sheets 17, 18, and 19:

Data sheets 17, 18, and 19 are used to compile and reduce the data obtained form the various operations surveyed in data sheets 13 through 16. Since data sheets 13 through 16 were filled out by crew chiefs and maintenance chiefs or NCOICs, the values recorded in data sheets 17 through 19 will have to be averages.

(a) List each type of aircraft in the base inventory.

(b) Enter the average time for completion of operation which is explained in the following paragraph.

The average time (hours) for completion of operation is entered on the data sheet for each operation involving AGE on each aircraft type. This value is obtained by adding the average amount of time spent by each piece of AGE in completing the specified operation on the specified aircraft type. The individual values for each peice of equipment should be averaged from values previously obtained from data sheets 13 through 16. It should be noted, however, that this value is not necessarily equal to the average time from the beginning to the end of operation and should in most cases be greater in value. For example, two pieces of equipment working together which complete an operation in 2 hours actually have an average time of completion of 4 hours as each worked 2 hours. (NOTE: Only the time of pieces of equipment which use the same type of fuels should be added.) Thus there should normally be two values of the average time for completion of operation: one value represents contributions of AGE using MoGas (column A); the second value represents contributions of AGE using JP-4 (column B).

d. Fuel Spillage, Vapor Displacement, and Fuel Venting

Fuel spillage, vapor displacement, and fuel venting refer to three completely different sources of hydrocarbon emissions. A brief description of each, a listing of the associated data required, and the parties that should be questioned to obtain data, and the sources of this data follow.

Data Sheet 17

COMPOSITE ROUTINE MAINTENANCE -- ALL AIRCRAFT
(AvGas - Column A, JP-4 - Column B)

Aircraft	Operation																		
	Preflight Inspection		Launch Ready Position		Engine Start		Oil Servicing		Refueling		Other								Basic Postflight Inspection		
											( )		( )		( )		( )				
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	

Data Sheet 18

COMPOSITE NON-FLIGHT MAINTENANCE ALL AIRCRAFT
(MoGas Column A, JP-4 - Column B)

Aircraft	Operation															
	Fuel Tank Recon-figuration		Brake and Tire Change		Navigation and Avionics		Field Maintenance						A/C Electrical Repair		Engine Change		Other (Please Specify)	
							Structural Repair		Corrosion Control		Hydraulic Repair							
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B

Fuel spillage as considered in this section of the guide deals only with fuel that is spilled in the aircraft parking areas during the refueling operation. The fuel spillage can occur by accidental overflow of the aircraft fuel tanks (i.e., not shutting off the filling valve at the proper time) or possibly by faulty equipment. The reason is not of major importance since only the quantity of fuel spilled is of interest. This data can be obtained by talking with the refueling crews. (A special point should be made with the crews that the placing of blame is of no interest whatever, that the only interest is in determining the amount and the frequency of spillage for input in AQAM.) Another source of data is the base fire department. After any spillage of major proportions the fire department must be notified so the spillage can be washed down. These values should cross check.

Vapor displacement or average refilling of aircraft occurs when an aircraft tank is filled; the vapor that is in the fuel tank is displaced and emitted into the air. By knowing the average amount of fuel delivered to each aircraft type, the amount of hydrocarbons that escape into the air can be calculated. The amount of vapor displaced can be obtained from the aircraft refueling crews who can indicate the average amount of fuel delivered to each aircraft type serviced. This data may have already been obtained if the fillup-to-flight ratio method for obtaining total numbers of flights was used. Another method is to use the total amount of fuel delivered to each aircraft type (obtained from fuels branch) and the number of takeoffs (obtained from flight records). By dividing total fuel by number of flights, an estimate of fuel delivered per flight can be determined. (Carefully check that the the amount of fuel delivered by either type of calculation is a realistic number.)

Fuel venting occurs after the jet engine on an aircraft is shut down. The fuel that remains drains into a receiver which is drained by maintenance crews, or it drains directly onto the pavement. While this may appear to be a small amount of fuel to consider, the quantity of fuel vented becomes significant when the number of engine shutdowns per year is calculated. The values needed under this heading can be obtained from pilots and crew chiefs who are most familiar with the specific type of aircraft in question. The example data sheets along with a further description of obtaining the data and entering it on the sheets follows.

(1) Instructions and Procedure for Completing Data Sheet 20: Fuel Spillage I

Data sheet 20 is used to obtain information regarding fuel spillage from the refueling of aircraft. Spillages almost always occur unless single-point refueling is practiced. This data should be filled out from information obtained from refueling crews.

(a) Enter each aircraft type in the base inventory.

(b) Enter the average amount of fuel spilled during refueling for that aircraft type.

(c) Give the previously assigned code for the parking area or refueling area where spillage occurs. If more than one parking area is used by a specific aircraft type, each parking area should be entered and the average fuel spillage at each location given.

(2) Instructions and Procedure for Completing Data Sheet 21: Fuel Spillage II

Data sheet 21 is used to obtain information regarding major fuel spillages from all operations. This data should be obtained from the base fire department.

(a) Enter the specific location (UTM coordinates) of each major fuel spillage which has occurred in the last year.

(b) Enter the quantity of fuel spilled and fuel type.

(c) Determine if possible the general reasons for the spillage.

(3) Instructions and Procedure for Completing Data Sheet 22: Aircraft Fuel Distribution

Data sheet 22 is used to obtain data about the distribution of jet fuel and aviation gas on the base.

(a) Fill out two forms, one for each type of fuel. Circle either aviation gas or jet fuel, depending on which is being reported.

(b) Enter the total gallons of aircraft fuel distributed yearly.

(c) Enter the gallons of aircraft fuel distributed by month.

(d) If the aircraft fuel is not distributed directly to the aircraft, give the information requested under Distribution Breakdown for Other than Aircraft.

Data Sheet 20

FUEL SPILLAGE I

Aircraft Type	Location	Average Spillage per Fueling

Data Sheet 21

FUEL SPILLAGE II
(Major Spills)

Location (UTM)	Quantity Spilled Gal.	Fuel Type	Reason for Spillage

(e) Indicate an average quantity of fuel that is delivered to each of the aircraft types including transients on a per-load basis.

(4) Instructions and Procedure for Completing Data Sheet 23: Aircraft Fuel Venting

Data sheet 23 is used to obtain information regarding the venting of unburnt JP-4 from jet engines that have been shut down.

(a) The data for this sheet should be obtained at the time of the pilot interviews (data sheet 6). These data should be transferred from the pilot interview sheets to data sheet 23. If this data was not gathered at the time of the interview, proceed to step (b).

(b) Another source of this data is from the crew chief responsible for each aircraft type.

(c) Enter each type of jet in the base inventory and the transient jets. Then enter the quantity of JP-4 vented per engine and the units.

2. AIRBASE SOURCES

There are four divisions of airbase sources: point sources, nonvehicular area sources, vehicular area and line sources, and other nonaircraft-associated line sources. These divisions were determined to facilitate data gathering.

a. Point Sources

A point source is any source which emits through a confining space, usually a smokestack. Stationary point sources as considered here are described in AQAM by the following seven basic parameters common to all point sources.

Stack height is the physical height of the stack as measured from ground level.

Initial horizontal dispersion parameter is an estimate of the horizontal dimension of the gas stream when the gas stream is no longer affected by plume rise. In most instances this parameter has been given a default value for the airbase point sources listed. In the absence of an available value, a good estimate would be to use twice the diameter of stack or exit port. (Plume rise is used here to define the vertical change of height that the centerline of the plume attains due to momentum and buoyancy.)

Initial vertical dispersion parameter is an estimate of the vertical dimension of the gas stream when the gas stream is no longer affected by plume rise. (Remainder as above in horizontal dispersion parameter.)

Data Sheet 23

JLT ENGINE VENTING

AIRCRAFT TYPE	QUANTITY VENTED PER ENGINE	REPORTING UNITS

Stack exit gas temperature is obtained from measurements made in the exhaust stack prior to the exhaust gases actually being emitted into the ambient air.

Stack exit gas velocity is obtained from measurements made in the exhaust stack prior to the exhaust gases actually being emitted to the ambient air. (In most cases, a default value is provided for both the exit gas temperature and velocity.)

Stack diameter is the diameter of the exhaust stack at the point of discharge.

Building height is the physical height of the building on which the exhaust stack is located.

The annual emission rate is needed in metric tons per year for each pollutant which is not from one of the following source categories:

Training fires
Turbine engine test facilities
Airbase power plants
Airbase incinerators
Storage tank point sources

These five point sources are considered to be typical point sources for most Air Force bases. They have been researched in considerable detail and thus require only a minimal amount of detailed information. Each of these emission sources will be discussed in terms of needed data and the sources for this information.

(1) Training Fires

Air Force training fires are intentionally set fires that usually employ JP-4 as the combustible fuel. These training fires are used to simulate an aircraft crash and are used as training for the fire fighting crews on the base. The fires in most cases are set at a specific location on the base, and these locations are used only for this purpose.

The best place to obtain data about training fires is the Base Fire Chief. He will usually direct the personnel directly involved with the actual training to cooperate and assist in the data acquisition.

The most important required data concerning training fires are the numbers of fires that take place annually, the amount of JP-4 used per fire (or other fuel, which should be specified if not JP-4), and the diameter of the fire pit.

(a) Instructions and Procedure for Completing Data Sheet 24: Training Fires

Data sheet 24 is used to obtain the necessary operational parameters for calculation of emissions from training fires.

1. A data sheet should be filled out for each training fire pit.

2. Enter the UTM coordinates location.

3. Diameter of Pit should be the diameter of the training fire pit actually used for the fire. This may or may not be the physical diameter of the pit; give units.

4. Enter the average number of gallons of JP-4 spread on this pit. (If another type of fuel is used, indicate quantity and type.)

5. Indicate by month the average number of fires.

6. Indicate under what atmospheric conditions a training fire would not be ignited.

7. Indicate under Usual Atmospheric Conditions for Burning the usual (if any) atmospheric condition prevailing when training fires are ignited.

8. Indicate the most common time of day that a fire is set under Usual Time of Day of Fire.

9. Indicate the usual duration of the training fire.

(2) Turbine Engine Test Facilities

The Air Force, as any large user of jet engines, has to periodically overhaul the engines in its inventory. After the engines are overhauled, they must be tested to determine whether they meet operational standards. These tests are conducted on bare jet engines in test cells, on outdoor test stands, and/or in noise suppressors in conjunction with a test stand. After this initial test, the engine is placed in an aircraft and further trim tests

Data Sheet 24

TRAINING FIRES

LOCATION (Base Map)

DIAMETER OF PIT

GALLONS OF JP-4 USED PER FIRE

NUMBER OF FIRES OF THIS SIZE PER MONTH	July	August	September	October	November	December	January	February	March	April	May	June

ATMOSPHERIC LIMITING CONDITIONS

Precipitation

Wind Speed

USUAL ATMOSPHERIC CONDITIONS FOR BURNING

Precipitation

Wind Speed

Season of Year

USUAL TIME OF DAY OF FIRE

DURATION OF FIRE

are performed. These can be accomplished in conjunction with a noise suppressor or on an area designated as a trim pad. Thus, there are five major configurations for testing the operational fitness of overhauled or recently repaired jet engines. These five methods are presented in table 4 along with the direction in which the exhaust is emitted.

Data for this segment should be obtained from the turbine rework facilities and the base civil engineering branch.

(a) Instructions and Procedure for Completing Data Sheet 25: Turbine Engine Test Facilities

Data sheet 25 will be used to measure the necessary operational parameters for the calculations of emissions from all turbine test facilities.

1. Fillout a data sheet for each test facility on the base and enter facility type from table 4 in the space provided.

2. Enter the location as a specific set of base map UTM coordinates. If there is more than one type of facility at that location, a separate sheet should be completed for each facility.

3. The physical dimensions of the facility should be entered in the appropriate spaces.

4. Under the appropriate headings the following information must be supplied:

a. Enter each engine type tested.

b. Number of runups per day is divided into two categories: average daily runups for the past year for each engine in question, and the maximum number of the specified engine type that are run up in a single day.

c. Average Time in Each Mode refers to the average amount of time that the engine is normally operated in the specified mode.

d. The average time that each engine type is tested in the maximum (afterburner) mode should be entered in the space provided.

e. If water injection is used, it should be indicated in the following manner:

Table 4

TURBINE TEST FACILITIES

Common designation of facility	Method of testing engine: Out of aircraft	Method of testing engine: In aircraft	Direction of exhaust plume
1. Test cell	X		Vertical
2. Outdoor test stand	X		A. Horizontal B. Vertical w/deflectors
3. Noise suppressor w/test stand	X		Vertical
4. Noise suppressor		X	Vertical
5. Trim pad		X	A. Horizontal B. Vertical w/deflector

If used in idle mode, indicate by placing a YI under the "Yes" column.

For normal cruise, enter YNC.

For military, enter YM.

For afterburner, enter YAB.

If water injection is not used at all for the engine in question enter 'No."

_f_. Enter the appropriate percentage of total runups that occur in each shift in the columns provided. The shifts, in most cases, correspond approximately to the following time periods: 0700 to 1500; 1500 to 2300; 2300 to 0700. Specify exact shift times at the base surveyed.

(b) Instructions and Procedure for Completing Data Sheet 26: Vertical Exhaust Turbine Test Facilities

Data sheet 26 will be used to obtain additional data about the operation of the exhaust and some of the physical parameters of vertical exhaust test facilities only (see table 4).

Data Sheet 25

TURBINE TEST FACILITIES

LOCATION

TYPE OF TEST FACILITY (See table 5)

PHYSICAL DIMENSIONS

Height of Building

Number of Exit Ports

Cross Section of Exit Port (Length x Width)

ENGINE TYPE	Number of Run-Ups per Day		Average Time in Each Run-Up Mode min.			Maximum Afterburner	Water Injection		Percentage of Run-Ups per Shift		
	Daily Av. Past Year	Maximum in One Day	Idle	Normal	Military		yes	no	1	2	3

Data Sheet 26

VERTICAL EXHAUST TURBINE TEST FACILITIES

Exhaust Opening

Temperature (^{0}K)	__________
Average Gas Velocity (m/sec)	__________
Diameter or Area of Opening (m)	__________
Pressure (in H_2O)	__________
Height above Ground of Opening (m)	__________
Height of Building (m)	__________
Initial Horizontal Dispersion (m)	__________
Initial Vertical Dispersion (m)	__________

TYPE OF COLLECTION DEVICE

Collection Efficiency

(attach report of test used to determine this)

1. For the exhaust opening, supply the data requested, if available.

2. Specify the type of air pollution control device in use, if any, and the collection efficiency of the device. Also attach a report on the testing of the device.

(3) Airbase Power Plants

The term power plants as used in this guide refers to large fossil fuel facilities used to produce steam for industrial processes and/or for heating large portions of the airbase. The exact classification of a power plant is dependent on the type of fuel consumed and the thermal input to the furnace in terms of Btu/hr. According to the EPA any boiler rated at more than 1.0×10^8 Btu/hr of heat input is a power plant. However, in this report boilers that have a Btu/hr heat input in the range of 1.0×10^6 to 1.0×10^8 are also considered as power plants. Boilers that are in the thermal input range below 1×10^6 Btu/hr and do not have air pollution control equipment installed will be considered as a space-heating source and will be dealt with later. However, boilers with air pollution control equipment must be considered as power plants no matter what their size.

The best source for infomation concerning power plant point sources is the base civil engineering office. This office should have a detailed record of every boiler on base that requires more than 0.75×10^6 Btu/hr heat input.

The second source of data is the individual in charge of each specific facility. This person will most likely have the best information on the operation of a specific unit.

The seven pieces of data that are common to all point sources (as outlined previously) must be determined when considering power plants because it is almost impossible to assign a default value to any of these seven basic parameters. Therefore, special emphasis is placed on obtaining this data.

(a) Instructions and Procedure for Completing Data Sheet 27: Power Plants I

Data sheet 27 will be used to obtain data concerning the operation of confined combustion sources (boilers) of a capacity greater than 1.0×10^6 Btu/hr and smaller boilers with any pollution equipment.

Data Sheet 27

POWER PLANTS I

BOILER TYPE MODEL

FUEL (attach fuel analysis report)

	Anthracite Coal	Bitumous Coal	Fuel Oil	Natural Gas	LPG Butane	LPG Propane	Other Fuel
Sulfur (Content)	___	___	___	___	___	___	___
Ash (Content)	___	___	___	N/A	N/A	N/A	___

Capacity = ___ over 1 x 10^8 Btu/hr
(Check one)

or

___ between 1 x 10^8 and 1 x 10^6 Btu/hr

or

___ less than 1 x 10^6 Btu/hr with air pollution equipment

BOILER SIZE (in terms of 10^6 BTU/hr. heat input)

Max. Capacity

Usual Load by Month

July August September October November December January February March April May June

FUEL CHARGING RATE (by month)

July August September October November December January February March April May June

LOCATION OF SAID **BOILER** (Base Map Coordinates UTM)

PURPOSE OF **BOILER** (Example, power generation, heating, etc.)

1. Complete a data sheet for each boiler. Supply the type of boiler, the manufacturer, and the model.

2. If available, attach an analysis of the fuel used in the boiler. If such an analysis is not available, indicate the sulfur and ash contents in terms of a percent.

3. For furnace size, give the maximum rated capacity in terms of 10^6 Btu/hr.

Enter data for either 4 or 5; number 5, Fuel Charging Rate, would be more desirable.

4. Under Usual Load by Month, enter what would be considered as an average heat load in terms of 10^6 Btu/hr for the month in question.

5. Under Fuel Charging Rate, estimate the amount of fuel charged to the boiler for the month in question.

6. For location of the boiler in question, give building designation and base map UTM coordinates.

7. Give a short description of the primary use for the boiler in the space provided next to Purpose of Boiler.

(a) Instructions and Procedure for Completing Data Sheet 28: Power Plants II

1. Under Stack Data, supply the data requested if available.

2. Specify the type of collection device in use, if any, and the collection efficiency of the device. Also attach a source test report on the device if available.

3. Indicate the type of air preheater if any.

4. For fuel oil boilers, indicate if the boiler is tangentially or horizontally fired.

5. Indicate the stack emissions, if available, and attach a copy of the report that supplied the information.

(4) Airbase Incinerators

The term incinerators in this guide means the process of controlled burning of waste material (paper, film, or pathological). An incinerator used for the disposal of large quantities of waste such as a municipal incinerator

Lata Sheec 28

POWER PLANTS II

Stack Data

Temperatur °F ____________

Average Gas Velocity (m/sec) ____________

Diameter or Area of Stack (m) ____________

Pressure (in H_2O) ____________

Height of Stack (m) ____________

Height of Building (m) ____________

Initial Horizontal Dispersion (m) ____________

Initial Vertical Dispersion (m) ____________

Type of Collection Device

Collection Efficiency

(attach report of test used to determine this)

Type of Air Preheater

Oil Fuel Only (tangentially fired or horizontally fired)

Stack Emissions

Results of tests (attach results of tests)

Particulates	Grain Loading	Size Analysis	Flow Rate
SO_x			
CO			
NO_x			
Other (________)			

is not included in this classification. If a large incinerator (municipal type) is in operation on the base, it should be treated in the same manner as a power plant of equal thermal capacity, i.e., data sheets in the previous section should be completed.

Due to the different types of waste material disposed of in incinerators, specialized designs have been developed and are in wide use. The three specific types that are covered in this guide are pathological, film, and paper. In some instances, film and paper are consumed in the same incinerator but usually at different times and under different operating conditions.

Pathological waste incineration at Air Force bases is usually limited to the immediate vicinity of the base hospital. The term pathological waste incineration is somewhat misleading in that substantial quantities of materials other than pathological material are normally incinerated. This "other" material consists of plastics, paper, and a wide variety of clinical and pathological laboratory waste.

The incineration of paper and film are considered together because some installations incinerate both types of material in the same piece of equipment. Although incinerated in the same piece of equipment, the materials are not usually incinerated together. The incinerators in this category are normally in the capacity range from a few pounds per hour to about a ton per hour. Large municipal incinerators with a charging capacity in terms of tons per hour will not be considered as a separate category to the proposed computer model at this time unless it is found that they are a source of air pollution at a large number of bases.

The first place to inquire about any incinerators located on the base is the base civil engineering office. This office should have very specific information about the locations of the incinerators, the designs, and the persons or groups responsible for operation and upkeep. Also, this office should know if air pollution control equipment had been installed.

After obtaining this information, the person directly responsible for operation of the specific incinerator should be contacted. This person should have detailed knowledge of its operation and the makeup of the material input.

(a) Instructions and Procedure for Completing Data Sheet 29: Incineration Data I

Data sheet 29 will be used to obtain operational and physical data to be used in the calculation of emissions from incinerators.

1. A data sheet should be completed for each type of material (paper, film, or pathological) incinerated in each base incinerator.

2. Circle the type material being incinerated.

3. The incinerator manufacturer and model number should be entered in the spaces provided.

4. Circle the appropriate designation for the number of chambers, single or multiple.

5. Enter in the spaces provided the design chamber temperatures for each chamber. If for some reason the incinerator is operated at other than design temperatures, indicate these temperatures in parentheses under the design conditions.

6. Enter manufacturer's design charging rate for each chamber and the average gas residence time.

7. Indicate if charging is continuous or not. If it is continuous, indicate the charging rate.

8. If charging is not continuous, enter the number of chargings per day.

9. Enter the usual amount of material charged per charging.

10. Indicate the composition of an average charge or if a continuous operation, indicate an average daily charge.

11. Enter the time of day of the chargings.

12. Enter the location of the incinerator as a set of base map UTM coordinates.

(b) Instructions and Procedure for Completing Data Sheet 30: Incinerator Data II

Data sheet 30 will be used to obtain additional data about the operation of the incinerators and some of the physical parameters of interest.

DATA SHEET 29

INCINERATION DATA I

(Paper) (Film) (Pathological)

Incinerator Manufacturer ____________ Model No. ____________

	Single Chamber	Multiple Chamber #1	Multiple Chamber #2
Design Chamber Temperature	____	____	____

Design Charging Rate ____________

Average Gas Residance Time (sec) ____________

Is Charging Continuous Yes No

Number of Chargings Per Day ____________

Composition of Charge ____________

Average Weight of Charge ____________

Time of Day of Charging or Chargings ____________

Location UTM Base Map Coordinates ____________

Building No. ____________

Data Sheet 30

INCINERATOR DATA II

(Paper) (Film) (Pathological)

Stack Data

Temperature (^{o}K) ____________

Average Gas Velocity (m/sec) ____________

Diameter or Area of Stack (m) ____________

Pressure (in H_2O) ____________

Height of Stack (m) ____________

Height of Building (m) ____________

Initial Horizontal Dispersion (m) ____________

Initial Vertical Dispersion (m) ____________

Type of Collection Device

Collection Efficiency ____________

(attach report of test used to determine this) ____________

Stack Emissions

Results of Tests (attach results of tests)

Particulates Grain Loading Size Analysis Flow Rate

SO_x

CO

NO_x

Other (____________)

1. A data sheet should be completed for each incinerator. Attach this data sheet to each completed data sheet 29.

2. Circle the type of material being incinerated.

3. For Stack Data, supply the data available.

4. Specify the type of collection device in use, if any, and the collection efficiency of the device. Also attach a report on the testing of the device.

5. Indicate the stack emissions, if available, and attach a copy of the report that supplied this information.

(5) Storage Tank Point Sources

The term storage tanks in this guide refers to those tanks that contain petroleum products before they are distributed to smaller storage and/or use facilities. The vast majority of petroleum products stored in tanks of this type will be AvGas, JP-4, fuel oil, and, in some instances, MoGas. Tanks that fall in this classification have a capacity greater than or equal to 5000 barrels (bbl) (1 bbl = 42 gal).

The use of 5000 bbl as a lower limit for classification of a tank under this heading is not absolute but is intended to give an indication of the relative size to be included.

If many storage tanks of the same size and construction are located in a confined area (tank farm), they should be considered as an area source, and data for them should be obtained later upon reaching the data sheets listed under Area Sources. The final decision whether to treat a facility as a point or an area source is left to the investigator, but it should be decided on the basis of the above criteria.

The primary source of physical data about storage tanks is again the base civil engineering office. This office should be able to supply specific drawings of the storage tank, configuration drawings of the fuel supply and distribution system, and a drawing of each tank. It is important to acquire drawings of the tanks to determine the tanks' breathing mechanisms and, in the case of floating roof tanks, how many seals are used to prevent vapor release.

The primary source of data about the functioning of each storage tank is the fuels management branch. In most cases the quantity of fuel that passes through each individual tank is not available. Only the yearly total received by all tanks is available. If this is the situation, the total amount of fuel through the system must be apportioned by the fraction of capacity represented by an individual tank to obtain an estimate of the quantity of fuel that passes through the specific tank in question on a yearly basis.

(a) Instructions and Procedure for Completing Data Sheet 31: Storage Tanks

Data sheet 31 will be used to obtain information about the storage tanks located on base.

1. Enter the tank designation for each tank in the space provided.

2. In the space provided, enter the type of material stored in the tank and the amount of product processed annually.

3. If the storage temperature of the product is kept at a temperature other than that of the surrounding air, enter the average yearly value.

4. Enter the physical data about the tank.

5. Attach a separate page explaining the vapor recovery system if you have entered "Yes" in the space provided.

(6) Other Point Sources

This heading was placed in this guide as a means of ensuring that any source of environmental pollutants peculiar to a base could be considered. Whether data on a source should be collected for AQAM depends on the significance of the source in terms of quantities of pollutants released and the nature of the pollutants released. To determine this, a comprehensive look must be taken, then a judgment must be made as to the significance of the specific source in question.

This procedure is, of course, not ideal, but it is the only one available because each Air Force base varies, especially from one Command to another.

DATA SHEET 31

STORAGE TANKS

TANK DESIGNATION					
PETROLEUM PRODUCT STORED					
ANNUAL THROUGHPUT OF PRODUCT					
HEIGHT					
DIAMETER					
WELDED					
RIVITED					
FIXED ROOF TANK					
Average Height of Vapor Space					
FLOATING TANK					
Pan Poontoon					
Single Double Seal					
PAINT TYPE					
PAINT CONDITION					
TANK CONDITION					
TANK ACCESSORY EQUIPMENT					
(Breather valve, gaging port, sample port)					
LOCATION (Base Map UTM)					
STORAGE TEMPERATURE					
VAPOR RECOVERY SYSTEM (YES, NO)					

Once again the primary source of information is the civil engineering branch on the base. This office should have knowledge of the different types of operations on the base. The next place to check would be the Environmental Coordinator on the base, who should have some idea what pollutants are being emitted, the quantity emitted, and their significance at the various sources being considered.

Another place to inquire whether or not a suspected source should be considered and/or its possible significance would be the Environmental Health Laboratory at McClellan AFB, CA.

An indication of what type of sources might be considered under this heading are as follows:

Emissions from dry cleaning facilities located on base

Emissions from plating shop, especially acid dip pickling tanks

Emissions from painting, both open area and spray booths

Emissions from heat treating operations

Emergency power unit emissions

Emissions from vapor degreasing operations

Although there probably will not be many "other" airbase sources of significance, this section should not be treated lightly. The absence of one significant source could cast doubts on the validity of the whole data gathering effort.

(a) Instructions and Procedure for Completing Data Sheet 32: Other Airbase Point Sources I

Data sheet 32 will be used to obtain data about other airbase point sources. Needed data include the type of operation location and the annual pollutant emission rate.

1. Indicate the type of operation being considered.

2. Supply the building number where the source is located.

3. Indicate the base map UTM coordinates.

4. List each pollutant emitted by the source and the quantity in metric tons emitted per year. Also indicate the source of the data from one of the following possibilities:

OTHER AIRBASE POINT SOURCES 1

Type of Operation ______________

Building Number ______________

Base Map Location UTM ______________ ______________

Annual Pollutant Emission Rate ______________

Pollutant	Quantity	Data Source

a. Stack source test data

b. Process weight calculation

c. Operator estimate

d. Other (describe)

(b) Instructions and Procedure for Completing Data Sheet 33: Other Airbase Point Sources II

Data sheet 33 will be used to obtain additional data about the operation of the source and some of the physical parameters of interest.

1. For Stack Data, supply the data requested, if available.

2. Specify the type of collection device in use, if any, and the collection efficiency of the device. Also attach a report on the testing of the device.

b. Area Sources (Stationary)

The term area source in this guide means a number of individual small sources closely related that can be considered as one source. An example of this is a number of small heating units in a residential area. This would be treated as an area source with dimensions of the residential area.

There are six specific area source types considered under the general heading, as follows:

Hydrocarbon filling and working losses

Storage tank area sources (hydrocarbon breathing and working losses)

Tank-truck parking areas

Military and civilian vehicle parking areas (evaporative emissions only)

Evaporative hydrocarbons from other sources

Space heating sources

Some of the area sources have physical boundaries associated with them which determine the area of the source. Examples of this are tank-truck parking areas and military and civilian parking areas. The area sources would consist of the area of the parking lots.

The remaining four types of area sources are more difficult to designate. Their size can only be determined after one knows the magnitude and location of each individual source, then these sources are grouped into specific areas. An

Date Sheet 33

OTHER AIRBASE POINT SOURCES II

Stack Data

Temperature (^{o}K) ______________

Average Gas Velocity (m/sec) ______________

Diameter or Area of Stack (m) ______________

Pressure (in H_2O) ______________

Height of Stack (m) ______________

Height of Building (m) ______________

Type of Collection Device

Collection Efficiency

(attach report of test used to determine this)

example of this would be hydrocarbon filling and working losses sources. This source classification includes loading racks, MoGas tanks in various parts of the base, diesel tanks, JP-4 tanks at the turbine test facilities, and the fuel oil tanks at individual houses. To determine the area sources one would have to first find how much fuel of each type was distributed to each location on base. After determining this, decide on the various areas that would best represent these individual sources. This should be done before any data sheets are filled out.

After determining the area sources, draw the perimeters on base maps. If the area approximates a square, no further breakdown is necessary; otherwise, subdivide into squares (not necessarily of equal size) approximating the original area. Assign an identification number to each square and record it on the map. Then each square is described by the following four terms:

Ground level coordinates of the center of the square area source
Average emission height of the pollutant source
Length of side of the square source
Initial vertical dispersion parameter

(1) Instructions and Procedure for Completing Data Sheet 34: Area Source

Data sheet 34 will be used to obtain the four terms described above.

(a) List each area source or, if the area source has been subdivided into square areas, list each subdivision.

(b) Assign and insert an identification number for each area source or subdivision.

(c) Provide the ground level coordinates of the center of each area source or subdivision.

(d) Enter the length of side of the square in meters.

(e) Enter the average emission height of the source. This is the distance from ground to emission point in meters.

(f) Enter the average initial vertical dispersion of the pollutant. The initial vertical dispersion parameter is an estimate of the vertical dimension of the gas stream when the gas stream is no longer affected by plume rise. In most instances this parameter has been given a default value for the

Data Sheet 34

AREA SOURCES

Identification No.	Center Coordinates	Length	Emission Height	Dispersion Height

airbase area sources listed. In the absence of an available value, a good estimate would be to use twice the diameter of stack or exit port. (Plume rise is used here to define the vertical change of height that the centerline of the plume attains due to momentum and buoyancy.)

(2) Hydrocarbon Filling and Working Losses

Hydrocarbon filling and working losses occur when fuel is transferred from one facility to another. There are two areas where this occurs: loading rack areas and distribution tank areas (tanks under 5000 bbl). Hydrocarbon filling and working losses occur at unloading rack areas when fuel is transferred from bulk storage to tank trucks. Fuel loss in tank areas occurs during two operations: transfer of fuel from tank trucks to distribution tanks and transfer of fuel from distribution tanks to final fuel receiver.

In all cases the only data that is required is the amount of each type of fuel that is processed through a given source on a yearly basis and an estimate of the amount of fuel spilled per year in the area source (for each fuel type) in metric tons.

The primary location for data for this section will be the fuels management branch. This office will be able to provide the quantities of fuel processed and probably an estimate of the amount of spills. Another place to obtain data about spills would be the tank-truck drivers, the receiving facilities, and the base fire department.

(a) Instructions and Procedure for Completing Data Sheet 35: Loading Racks

Data sheet 35 will be used to determine the emissions from the tank-truck loading racks area. If data sheet 34 has not been filled out on all of the area sources included in this data sheet, fill it out at this time.

1. Use a different data sheet for each loading location or square subdivision.

2. Provide the area source or subdivision with an identification number.

3. If the loading rack employs a vapor recovery system, describe the type employed.

DATA SHEET 35

TANKS TRUCK LOADING RACKS

1. Identification Number
2. Vapor Recovery System on Loading Rack
3. Vapor Recovery System on Truck
4. Amount Through Loading Racks Yearly

   AvGas JP4 Gasoline Diesel Fuel Oil Solvents Deicing Fluid Other (Specify)

5. Amount Spilled Yearly at Loading Racks

   AvGas JP4 Gasoline Diesel Fuel Oil Solvents Deicing Fluid Other (Specify)

4. If the truck employs a vapor recovery system when receiving the product, describe it.

5. Enter the total amount of each fuel type delivered through the loading rack yearly.

6. Enter the total amount of each fuel type lost through spillage on a yearly basis.

(b) Instructions and Procedure for Completing Data Sheet 36: Petroleum Distribution Tanks

Data sheet 36 will be used to obtain information about distribution tanks on the base. Distribution tanks are storage facilities under 5000 bbl located at the point of distribution to the final receiver. The major losses from these tanks are considered to be breathing and working losses and spillages. If data sheet 34 has not been filled out on each area source, do so at this time.

1. Fill out a data sheet on each distribution tank area source or subdivision. Enter the area source code number from data sheet 34.

2. Specify the type of fuel (MoGas, JP-4, etc.).

3. Determine the total yearly amount received.

4. Make an estimate of the yearly amount of petroleum product spilled.

(3) Storage Tank Area Sources (Hydrocarbon Breathing and Working Losses)

This part of the report should be ignored for those storage tanks that were considered as point sources. This part will probably find its greatest use in considering a tank farm where a number of storage tanks of approximately the same design are located.

The primary location for all of the required data is the fuels management branch. This branch should be able to provide all of the data required. If for some reason they do not have all of the physical data needed, the base civil engineering office should be contacted.

(a) Instructions and Procedure for Completing Data Sheet 37: Storage Tank Area Sources

Data sheet 37 will be used to obtain information about the storage tanks and area sources located on base. If data sheet 34 has not been filled out on each area, it should be completed at this time.

Data Sheet 35

PETROLEUM DISTRIBUTION TANKS

AREA SOURCE	FUEL TYPE	YEARLY TOTAL RECEIVED	YEARLY AMOUNT SPILLED

DATA SHEET 37

STORAGE TANK AREA SOURCES

TANK DESIGNATION					
PETROLEUM PRODUCT STORED					
ANNUAL THROUGHPUT OF PRODUCT					
HEIGHT					
DIAMETER					
WELDED					
RIVITED					
FIXED ROOF TANK					
Average Height of Vapor Space					
FLOATING TANK					
Pan Poontoon					
Single Double Seal					
PAINT TYPE					
PAINT CONDITION					
TANK CONDITION					
TANK ACCESSORY EQUIPMENT					
(Breather valve, gaging port, sample port)					
LOCATION (Base Map UTM)					
STORAGE TEMPERATURE					
VAPOR RECOVERY SYSTEM (YES, NO)					

1. Enter the tank designation for each tank in the space provided.

2. In the space provided, enter the type of material stored in the tank in question and the amount of product processed annually.

3. If the storage temperature of the product is kept at a temperature other than that of the surrounding air, enter the average yearly value.

4. Enter the physical data about the tank.

5. Enter the UTM-base map coordinates for the tank in question.

6. Attach a separate page explaining the vapor recovery system if "Yes" has been entered in the space provided.

(4) Tank-Truck Parking Areas

Tank-truck parking areas are those areas where petroleum tank trucks are parked by day and/or night. This is not intended to be used to define each place that a tank truck might stop for a short period.

The information required under this heading can be obtained from the fuels management branch and/or from the motor pool where the truck is serviced.

(a) Instructions and Procedure for Completing Data Sheet 38: Tank-Truck Parking Areas

Data sheet 38 will be used to obtain data on tank trucks within each tank-truck area. If data sheet 34 has not been filled out on each area, it should be completed at this time.

1. Fill out a separate data sheet on each area or subdivision if the area has been broken down, and enter the identification number from data sheet 34.

2. Enter the capacities, diameters, and the number of tank trucks of each capacity in the area or subdivision if appropriate.

3. Indicate the average percent of tank capacity loaded per truck loading.

4. Indicate the average percent of tank capacity holding fuel when truck is returned to the parking area.

Data Sheet 38

TANK TRUCK PARKING AREAS

Identification Number ____________

Tank Truck Capacity/Diameter/Number ____________

Average % of Tank Capacity Loaded ____________

Average % of Tank Capacity Fuel After Delivery ____________

(5) Military and Civilian Vehicle Parking Areas (Evaporative Emissions Only)

The term parking areas (both civilian and military) refer to areas in which vehicles are parked for a period of time, usually at least 4 hours. Some type of survey of parking areas completed in the near past should be available. If not, the next best procedure is to obtain a small base map and proceed by car to each parking area on base to obtain a vehicle count and record the type of vehicles in the respective areas.

The data obtained in this portion of the guide will be used to calculate hydrocarbon emissions only. This is not to be confused with emissions from operation of the motor vehicle. Emissions from the operation of the motor vehicles in parking areas will be considered under subsection c, Motor Vehicle Sources (Area-Lines).

(a) Instructions and Procedure for Completing Data Sheet 39: Parking Areas

Data sheet 39 is to be used to obtain the number and type of vehicles (cars, trucks, etc.) that are parked in the various parking areas or subdivisions of these. If data sheet 34 has not been completed for each parking area or subdivision, do so at this time.

1. Fill out a data sheet on each parking area or subdivision if the area has been divided, and enter its code number from data sheet 34.

2. Enter the average number of vehicles parked in the area at any one time during weekdays.

3. Enter the types of vehicles parked there and the percentage of each type of vehicle.

(6) Evaporative Hydrocarbons from Other Sources

This section of the guide will be used to survey and report any source of hydrocarbon emissions that have not previously been covered. Three general sources on all bases in this classification are the base exchange service station, the various military refueling (car, truck) service stations, and the AGE refueling facility. Other possible sources not necessarily on every base are emissions from "industrial" sources that might consist of many small emission sources. An example is a hangar in which there are a number of vapor degreasing units. For the examples just presented, the size of the

Data Sheet 39

PARKING AREAS

Parking Source Identification Number

Average Week Day No. Of Vehicles

Type of Vehicles	Percent of Total

distribution tanks is not important. The important factor is the quantity of petroleum fluid distributed to each area. Based on the amount of fluid dispersed to individual users, annual hydrocarbon emission in metric tons can be determined.

As with Other Point Sources, the gathering of data and reporting on Other Area Sources depends upon the significance of the source in terms of hydrocarbons released.

The primary source of data for this section is the fuels management branch, the base exchange (BX) service station, and the Base Bioenvironmental Engineer.

(a) Instructions and Procedure for Completing Data Sheet 40: Other Area Sources

Data sheet 40 will be used to obtain data about evaporative hydrocarbon sources not previously covered elsewhere. If a copy of data sheet 34 has not been filled out previously, complete it now.

1. Enter the identification number for each source.

2. Enter a descriptive name for the source and hydrocarbon type.

3. Provide an estimate of the amount of hydrocarbon replaced over the year due to evaporation loss.

(b) Instructions and Procedure for Completing Data Sheet 41: Service Stations

Data sheet 41 will be used to obtain data about the distribution of petroleum products to service stations and the amount delivered to cars and trucks per month. If data sheet 34 has not been filled out previously, complete it now.

1. Enter the area source identification number for each base motor pool and service station.

2. For tank capacity, the capacity of each tank at the station should be entered.

3. Splash or submerged fill refers to the method that the service station tanks are filled.

4. Under Gallons Pumped, enter the number of gallons of gasoline pumped by month.

Data Sheet 40

OTHER AREA SOURCES

Source Identification	Source Description	Type of Hydrocarbon	Evaporative Hydrocarbon Loss Gal.

Data Sheet 41

SERVICE STATIONS

Area Source Identification	Tank(s) Capacity	Splash Fill	Submerged Fill	Gallons Pumped											
				July	Aug.	Sept.	Oct.	Nov.	Dec.	January	February	March	April	May	June

(7) Space Heating Sources

Space heating as used in this guide refers to systems that are primarily employed to supply heat for environmental temperature control. These heating units will be located usually in individual residences and in small office buildings. As long as the thermal heat input requirements are less than 1×10^6 Btu/hr and the unit is used for comfort heating, the unit falls under this heading. If the heat input is greater than 1×10^6 Btu/hr, the source should be considered as a point source. These units will usually be located in groups that correspond to the base housing areas and office areas. These areas should be divided into reasonable size square units and the required data obtained for each unit.

The major source of data for this section is the base civil engineering branch. This office keeps very accurate records of fuel consumption and divides this information into residential use and main base use. This office also maintains a record of the heat input rating for all of the space heaters and boilers located on the base and which are registered in the property inventory.

(a) Instructions and Procedure for Completing Data Sheet 42: Space Heating

It is very doubtful that a central power plant will supply the steam necessary to heat all facilities on a base. Therefore, any building that is not supplied by a centrally located plant will have its own means of producing heat. Single-family housing is the most likely candidate for inclusion as a source, but other possible sources are BOQs, dormitories, base businesses, and office buildings. Data sheet 42 will be used to obtain information about the operation of the space heating units on base. It should be used only for sources with less than 1.0×10^6 Btu/hr heat input. If data sheet 34 has not been filled out for each area heating source, do so at this time.

1. Fill out a data sheet for each square area source or square unit if the source has been subdivided and insert the identification number.

2. Specify type of fuel used in the furnaces in the upper right-hand corner (a form must be filled out for each fuel type).

3. If available, attach an analysis of the fuel used in the furnaces. If one is not available, indicate the sulfur and ash content in terms of a percent.

4. For fuel charging rate, estimate the amount of fuel charged to all the furnaces in the area for the month in question.

5. Purpose of Furnaces is to be filled in only if the furnaces are used for purposes other than space heating.

c. Motor Vehicle Sources (Area-Line)

This subheading is to be used to obtain data about the distribution of military and civilian motor vehicle operations on the base.

Motor vehicle sources are divided into both area and line sources. The most difficult problem in obtaining this data will be deciding the distribution of vehicle miles between area sources and line sources.

The criteria for determining whether a motor vehicle source should be treated as an area source or a line source is as follows.

Area source describes emission sources that usually consist of a number of individual small sources that may be either stationary or mobile. For military vehicles this would be areas in which there is a considerable amount of activity that is not confined to a specific roadway. This would be those sources that have fairly easily defined boundaries but are too large to be considered as point sources. Two examples of sources that should be included under this classification are the motor pool areas and the areas adjacent to the flight line. Motor vehicle area sources are treated in the same way as other area sources. They are divided into square areas and the following data is needed to describe its physical location:

Ground level coordinates of the center of the square area source
Average emission height of the pollutant source
Length of side of the square source
Initial vertical dispersion parameter

Line sources are produced by the operation of a pollution source along a defined path. The path (a roadway) has a defined length and a definite width. The length of the entire roadway is divided into straight line segments, and the total mass of the emitted pollutant is then distributed appropriately. The following data is required to describe the line source:

The average emission height (for a motor vehicle this would be the height above the ground of the exhaust pipe)

Width of line (for a motor vehicle roadway it would be the physical width of the roadway)

Initial vertical dispersion parameter (for a motor vehicle this would be the approximate physical height of the vehicle)

Ground level coordinates for each end of the individual line segment (these would be obtained from the base map)

Data sheets are divided into military area and line sources and civilian area and line sources because the data acquisition is considerably different for military and civilian vehicles.

(1) Military Vehicle Sources

Area sources and line sources are considered together under this heading since both require the same type of information and this information should be available at the same location.

There three basic data areas concerning military vehicles that must be provided: vehicle miles, emission factors, and vehicle speed. All military vehicles are divided into six classes and vehicle miles driven are reported by class. These classes are described in table 5.

Table 5

VEHICLE CLASS DEFINITIONS

Class	Definition (gross vehicle weights in pounds)
1	Cars
2	Light-duty trucks (GVW $\leq$ 6000)
3	Trucks (6000 < GVW < 16,000)
4	Trucks (16,000 < GVW < 33,000)
5	Trucks (GVW > 33,000)
6	Diesel-powered vehicles

In obtaining the regularly military vehicle miles driven on base, begin with the Base Transportation Officer. He controls all records pertaining to vehicles on base, thus his permission is required before any data is released.

After briefing the Base Transportation Officer, proceed to the Base Resident Auditor. The Base Resident Auditor, along with the base data processing section can obtain a computer printout detailing a variety of data, including miles driven, about each vehicle on base. An example of some of the output is provided in table 6.

The Base Resident Auditor will also assist with an interpretation of the computer output. Air Force Manual 300-4 will also help to interpret the computer output. This manual describes the vehicle code designation that appears on the left-hand side of the computer output. Copies of the necessary pages from AFM 300-4 are presented in appendix B. If the printout is not available, a copy will have to be obtained. Before the data can be retrieved (it is stored on magnetic tape in the Air Force Audit/MANAGEMENT System (AFA/MS), a retrieval program must be written and coded. Beginning on page A-48 in AFM 175-118, the required retrieval programs are presented; the resident auditor and personnel from the data management system will assist with this program.

When the number of miles traveled on the base by each of the vehicle classes is determined from the computer output, the next step is to determine the area and line sources and to distribute among these sources the total miles traveled. A specific method for making this distribution does not exist, so final decisions are left to the person collecting the data. Discussions with the Base Transportation Officer, with personnel from the security police office, and with personnel from the units doing the most driving on the base should clarify which sections of the base most nearly fit the definition of an area source and which would be more accurately described as a line source.

After determining the source, the number of vehicle miles by class must be distributed. This task can be simplified by obtaining a document produced for each base by Military Traffic Management and Terminal Service. This document (if it has been completed for the base in question) consists of a complete survey of an installation's traffic pattern. The mailing address for this agency is

Military Traffic Management and Terminal Service
Transportation Engineering Agench
12388B
Warwick Blvd
P. O. Box 6276
Newport News, VA 23606

Table 6

EXAMPLE OF OUTPUT ON VEHICLE DATA

PREPARED 73 AUG 22 AFAMS REPORTS PCN M118011

DATA FROM MASTER RECORDS OF SELECTED GENERAL PURPOSE VEHICLES

USAF MAN COD	VEH REG N	MILES-HOUR ACCUMULATE VE	RESULT FOUR	ASSN ORG	MILES 1-MT H	MILES 2-MT H	MILES 3-MT H	MILES 4-MT H	MILES 5-MT H	MILES 6-MT H
8102	73403662	1602	878	0A	193	683	2	0	0	0
	* USAF MAN CODE		8102							
	RESULT FOUR			153260						
	RESULT FOUR	AVERAGE IS		4142						
	USAF MAN CODE		GROUP COUNT IS		37					
8111	47809453	57012	921	0A	232	64	68	151	309	97
8111	47913807	67791	0	0A	0	0	0	0	0	0
8111	68801121	44960	6992	0A	710	1696	1061	734	1354	1437
8111	68301180	47849	1064	0A	334	463	124	0	21	122
8111	68801220	59435	4329	0A	171	657	309	1276	592	1334
8111	68801405	62246	4473	0A	1204	76	385	743	1480	545
8111	68801439	77233	5867	0A	1383	1309	1358	916	659	242
8111	68301475	65659	7079	0A	1273	1004	947	633	819	2403
8111	69800979	57021	6051	0A	1550	1753	1160	109	919	561
8111	69300980	46333	11739	0A	455	297	1481	2488	3986	2031
8111	69800981	50379	6630	0A	785	1192	1491	515	553	2144
8111	69801133	57372	6263	0A	330	319	1785	1095	1639	1135
8111	69801136	52979	4859	0A	1330	1826	1559	1361	1626	1137
8111	70302732	38934	0	0A	0	1	0	0	0	0
	* USAF MAN CODE		8111							
	RESULT FOUR			69266						
	RESULT FOUR	AVERAGE IS		4948						
	USAF MAN CODE		GROUP COUNT IS		14					
8112	66808945	73009	3725	0A	172	1316	1143	1135	903	56
8112	66808958	64978	3003	0A	343	715	739	178	653	375
8112	66809005	68871	5631	0A	311	1084	403	1942	1423	464
8112	66809054	69964	4640	0A	1392	705	1092	956	437	58
8112	66809087	79884	4635	0A	673	1307	1325	849	74	407
8112	67801956	71277	3904	0A	960	291	470	1184	701	298
8112	67801946	40800	4315	0A	1164	1638	404	776	56	277
8112	67801949	76602	4028	0A	458	1101	1072	34	688	695
8112	67401973	42105	5159	0A	1433	816	356	826	629	1105
8112	68801603	23690	2346	01	380	0	252	1083	562	109
	* USAF MAN CODE		8112							
	RESULT FOUR			42386						
	RESULT FOUR	AVERAGE IS		4239						
	USAF MAN CODE		GROUP COUNT IS		10					

This survey if available should be used with some degree of caution because the vehicle counts do not distinguish between military and civilian vehicles. If this survey is not available, the next best method for obtaining this information is estimates made by the base transportation officer, personnel from the security police office, and personnel from the units doing most of the driving on base. Also, from these discussions one should decide on the type of emission factor that best fits vehicle activity in the source. The possible emission factors are hot-running emission factors, cold-running emission factors, and combined hot- and cold-running emission factors.

The source has a hot-running emission factor if the great majority of the vehicles have been in operation for a period of at least 15 minutes before entering the source. For example, the flight line area would have a hot-running emission factor.

The source would be considered as having a cold-running emission factor if the vehicles had been idle for a period of more than 4 hours. An example of this would be a parking area. If the cold-start emission factor is indicated, one has to obtain the annual number of cold starts. For example, a motor pool parking area where most of the vehicles would be started at least once a day can be used to calculate the annual cold start.

The area would best be considered as a combination of hot and cold emission factors if the vehicles within the area cannot meet either of the above requirements. An example of this would be the motor pool where vehicles have sat idle overnight or during the day, but also with normal vehicle traffic in the area. Another example would be the hospital parking area on base. However, if this area has a limited amount of through traffic or activity during the day, it would probably qualify for a cold-running emission factor rating.

The average route speed must be obtained from the base security police or from personal observations.

As in the section concerning parking area source evaporative losses, one should use (and mark directionally on) a base map the area and line sources that are being considered. This map is invaluable for data record keeping and for further data reduction at a later date.

The following is a review of the procedure to be used in gathering the data for the military vehicle section:

1. Contact the Base Transportation Officer and Base Resident Auditor, then obtain the vehicle miles computer programs. This should be done in sufficient time previous to a base visit so the data can be prepared (4 weeks).

2. Fill out the forms to be used for the vehicle mileage distribution by vehicle class and age using the computer output.

3. Determine the location (on the base map) of the vehicle area sources and line sources and assign them a convenient code number.

4. Indicate on the data sheets supplied the source code number and the percentage of the total miles for each vehicle class driven in the respective source.

5. Enter a "1" for hot-running emission factor, a "2" for cold-running emission factor, and a "3" for combined hot- and cold-running emission factors.

(a) Instructions and Procedure for Completing Data Sheet 43: Military Vehicles

Data sheet 43 will be used to determine the number of military vehicles by class, model year, and the amount of mileage that each model year is driven. It is completed by using the computer printout.

1. Fill out a data sheet for each vehicle class and circle the class for which it is filled out.

2. The information required is as follows:

a. Number of vehicles of each model year.

b. Total mileage for each vehicle year by month.

c. Total mileage for each vehicle year by year.

d. Total number of all vehicles and total mileage driven by all vehicles.

(b) Instructions and Procedure for Completing Data Sheet 44: Military Vehicle Distribution by Class

Data sheet 44 will be used to obtain data necessary for calculating the emissions from military vehicles. In addition to the two data sheets to be completed, a base map showing roadways is required; data sheet 44 is used in conjunction with the base map to determine the usage distribution of vehicles on base.

MILITARY VEHICLES

Class (circle one)

I II III IV V VI

Model Year	Number	Mileage by Month (on Base)												Mileage by Year (on Base)
		July	August	September	October	November	December	January	February	March	April	May	June	
1960														
1														
2														
3														
4														
5														
6														
7														
8														
9														
1970														
1														
2														
3														
4														
5														
6														

(1) The unit that is specified will probably have to be surveyed to determine the number of cold starts and percentage of vehicles in use and/or the area of operation.

Data Sheet 44

MILITARY VEHICLE DISTRIBUTION BY CLASS

Source Designation	Average Speed	Percentage (P) and Emission Factor (EF) By Vehicle Class I		II		III		IV		V		VI	
		P	EF*	P	EF*	P	EF*	P	EF*	P	EF*	P	EF*
Roadway Designation (Line Source)													
Area Designation (Mobile Area Source)													
Parking Area Designation (Non Mobile Area Source)													

*Emission Factors: 1 - hot running, 2 - cold running, 3 - combination of cold and hot running. Cold starts should be indicated by ( ) next to the emission factor.

1. On the base map that shows roadways and parking areas, indicate by consecutive numbers the following information:

a. Major roadways used by military vehicles.

b. Areas in which there are no definite roadways but are used by vehicles (for example, hangars and apron areas).

c. Parking areas for military vehicles (for example, parking areas near motor pools or vehicle storage areas).

2. On data sheet 44 list the roadway by the numbers given on the base map. Supply the percentage of total miles driven by each vehicle class for the specific lines.

3. List the use areas by the number given on the base map. Supply the percent of total miles driven by each vehicle class for the specific area and the emission factor type (i.e., 1, 2, or 3).

(NOTE: Vehicle class mileage rather than percent of total miles can be supplied if available for both area and line sources.)

4. List the vehicle parking areas by the number given on the base map. Estimate the number of vehicle miles driven in the lot.

5. For all sources enter the average speed driven by the vehicles within the sources.

(c) Instructions and Procedure for Completing Data Sheet 45: Military Vehicle Distribution by Time Period

Data sheet 45 will be used to determine any significant weekly or hourly pattern in the vehicle traffic on base.

1. Indicate the variation of military traffic for each of the 3-hour blocks of time. This should be done by indicating the percentage of the total military traffic flow for the period considered.

2. Indicate the weekly pattern that may exist in the military vehicle activity. Use the same procedure as 1.

(2) Civilian Vehicle Sources

Civilian vehicles for the purpose of this report are those vehicles that are not owned by the US Government. Therefore, vehicles owned by military personnel, even though the personnel may live on a military

Data Sheet 45

MILITARY VEHICLE DISTRIBUTION BY TIME PERIOD

DIURNAL VEHICLE DISTRIBUTION

Time Period	Percent of Total
0001-0300	______
0301-0600	______
0601-0900	______
0901-1200	______
1201-1500	______
1501-1800	______
1801-2100	______
2101-2400	______

WEEKLY VEHICLE DISTRIBUTION

Day	Percent of Total
Monday	______
Tuesday	______
Wednesday	______
Thursday	______
Friday	______
Saturday	______
Sunday	______

reservation, are considered in the civil emission source category. Civilian vehicles are mainly used to transport personnel to and from work. The other major use of vehicles in this class would be that of on-base driving between home and base businesses.

Line sources under this classification consist of major roadways used by civilian vehicles. Area sources under this classification are the areas around the base exchanges, the areas near the base hospital, other concentrations of civilian vehicle activity that cannot be assigned specifically to a defined roadway, and civilian parking areas.

The data for this section will of necessity be a best estimate by the person completing this section because records of civilian vehicles are not maintained in the same detail as military vehicles. The specific data required consist of the following:

Annual vehicle miles driven within the area or on the line source.

Average speed within the area or on the line source.

Whether the vehicle uses
- Hot-running emission factors
- Cold-running emission factors
- Combined hot- and cold-running emission factors

The data required for the civilian vehicle portion of this guide are the same as for the military vehicle portion just completed, but the gathering of the data and the data that are available are considerably different.

There are three possible methods to obtain the total civilian mileage on the base, and none are completely satisfactory. The first (and probably the best) is to use the base traffic survey (discussed in the military data section). Although this document does not distinguish between military classes and/or civilian vehicles, the document does give a total vehicle count. This would at least give a good description of the relative travel patterns on the base. From these travel patterns a mileage distribution could be determined. With this survey and knowing the military vehicle mileage, the total mileage attributable to the civilian population can be determined. The second method is to estimate an average mileage figure driven by all cars entering the base and to obtain a vehicle count at the gates of the base for an average day.

With these two figures an idea can be obtained of the civilian vehicle mileage on the base for a given average work day. The third method is to obtain the number of military personnel on the base, then by estimating an average mileage figure for base travel and the national car-pool ratio, obtain an idea of the mileage driven on base by civilian vehicles.

The average speed within the area or line source corresponds to the speed limit.

The emission factors are the same as for military vehicles.

No attempt is made to obtain data by vehicle class for civilian vehicles. This data is not readily available. Of course, if by chance, mileage by vehicle class is available for civilian vehicles, it should be obtained.

The base security police office is the best place to begin gathering this data. Surveys are conducted to obtain base traffic counts, and the security police would be best qualified to give estimates of the average mileage for civilian vehicles and military POVs.

As with the military data section, the most difficult task will be to distribute the total vehicle mileage between the area and line sources, then to distribute the fraction of total mileage among the various individual area or line sources. The only advice that can be supplied for this task is to talk with the security police section, personnel who have been in residence at the base for a long period of time, and to observe personally, then make a judgment.

(a) Instructions and Procedure for Completing Data Sheet 46: Age Distribution of Civilian Vehicles

Data sheet 46 will be used to obtain data concerning the number and the age distribution of all nonmilitary vehicles having base stickers or permission to enter the base in question.

1. Enter the number of vehicles registered on base by model year.

(b) Instructions and Procedure for Completing Data Sheet 47: Civilian Vehicle Distribution by Time Period

Data sheet 47 will be used to determine any significant monthly, weekly, or hourly pattern in the vehicle traffic coming into the base.

1. Indicate the variation of civilian traffic for each of the 3-hour blocks of time by indicating the percentage of the total civilian traffic flow for the period considered.

DATA SHEET 46

AGE DISTRIBUTION OF CIVILIAN VEHICLES

MODEL YEAR	NUMBER	COMMENTS
1960		
1		
2		
3		
4		
5		
6		
7		
8		
9		
1970		
1		
2		
3		
4		
5		
6		
TOTAL		

Data Sheet 47

CIVILIAN VEHICLE DISTRIBUTION BY TIME PERIOD

DIURNAL VEHICLE DISTRIBUTION

Time Period	Percent of Total
0001-0300	__________
0301-0600	__________
0601-0900	__________
0901-1200	__________
1201-1500	__________
1501-1800	__________
1801-2100	__________
2101-2400	__________

WEEKLY VEHICLE DISTRIBUTION

Day	Percent of Total
Monday	__________
Tuesday	__________
Wednesday	__________
Thursday	__________
Friday	__________
Saturday	__________
Sunday	__________

2. Indicate the weekly pattern that may exist in the civilian vehicle activity. Use the same procedure as 1.

(c) Instructions and Procedure for Completing Data Sheet 48: Civilian Mileage Distribution

Data sheet 48 will be used to obtain data necessary to calculate the emissions from civilian vehicles. In addition to the data sheet to be completed, a base map showing roadways is required.

1. On the base map that shows roadways and parking areas, indicate by consecutive numbers the following information:

a. Major roadways used by civilian vehi es.

b. Areas in which there are no definite roadways, but are used by vehicles (an example of this would be BX and hospital areas).

c. Parking areas for civilian vehicles (an example of this would be parking areas near motor pools or vehicle storage areas).

2. On data sheet 48 list the roadway by the number given on the base map. Supply the percentage of total civilian miles driven on the base that can be attributed to this source.

3. On data sheet 48 list the use areas by the number given on the base map. Supply the percentage of total civilian miles driven on the base that can be attributed to the source and the emission factor that best describes the types of travel.

4. On data sheet 48 list the vehicle parking areas by the numbers given on the base map. Supply an estimate of the total mileage driven in the lot after starting a car.

(d) Instructions and Procedure for Completing Data Sheet 49: Summary of Vehicle Emissions

This data sheet is a summary of mileage distribution on the base.

1. Indicate total military/civilian mileage.

2. Indicate portion of the total mileage assigned to all area sources by vehicle class.

3 Indicate the portion of the total mileage assigned to all line sources by vehicle class.

Data Sheet 48

CIVILIAN VEHICLE DISTRIBUTION

Source Designation	Average Speed	Percentage (P) and Emission Factor (EF) By Vehicle Class											
		I		II		III		IV		V		VI	
		P	EF*	P	EF*	P	EF*	P	EF*	P	EF*	P	EF*
Roadway Designation (Line Source)													
Area Designation (Mobile Area Source)													
Parking Area Designation (Non-Mobile Area Source)													

*Emission Factors: 1 - hot running, 2 - cold running, 3 - combination of cold and hot running. Cold starts should be indicated by ( ) next to the emission factor.

Data Sheet 49

SUMMARY OF VEHICLE EMISSIONS

Civilian Vehicle Data ____________

Military Vehicle Data ____________

Total Civilian Mileage ____________

Total Military Mileage ____________

Fraction considered for Area Sources by Vehicle Class (Military) ____________

Fraction considered for Line Sources by Vehicle Class (Military) ____________

Fraction considered for Area Sources (Civilian) ____________

Fraction considered for Line Sources (Civilian) ____________

Comments

4. Under Comments, describe how the total mileage figure was obtained and how the mileage breakdown was determined by source type.

d. Other Line Source

This term line source is used to describe an emission source produced by the operation of the source other than vehicular (primarily locomotives) along a defined path. The path (railbed) has a defined length and a definite width. The length of the entire railbed is divided into straight line segments and the total mass of the emitted pollutant is then distributed appropriately.

The basic data requirement for all headings under this section are as follows:

The average emission height (for a locomotive this is the height of the smoke stacks).

Width of line (for a locomotive it would be the physical width of the railbed).

Initial vertical dispersion parameter.

Ground level coordinates for each end of the individual line segment (these should be obtained from the base map).

(1) Instructions and Procedure for Completing Data Sheet 50: Line Sources

Data sheet 50 will be used to obtain information about the operation of diesel-powered locomotives on Air Force bases.

(a) The type of locomotive (diesel, gas, electric) should be entered in the space provided (one form for each locomotive type).

(b) Give the best estimate available for the average fuel usage of the locomotive by month.

(c) Enter the usual speed of the locomotive. If this speed varies by more than 10 mph through the base, the individual speeds should be indicated next to the railbed location.

(d) The location of the railbeds should be indicated on a copy of the base map. These railbeds should be divided into straight line segments.

(e) The individual segments should be given a numerical designation. The coordinates of each end of the line segment should be provided.

Data Sheet 50

LINE SOURCES - LOCOMOTIVE

TYPE OF LOCOMOTIVE

Total Amount of Fuel Used by Month

July	August	September	October	November	December	January	February	March	April	May	June

USUAL SPEED

Rail Bed		End Coordinates			
Designation	X	Y	X	Y	Fuel Consumed

(e) Provide an estimate of the percentage of total fuel consumed by the locomotive for each line segment.

3. ENVIRON SOURCES

This part of the guide presents a method of obtaining data to estimate the air quality of the region surrounding an airbase. It can be considered as optional if one is not trying to quantitatively asses the influence of the airbase on the surrounding air quality. For example, if one is only trying to determine the effect of some change in the base's operation on a specific group of receptors and thus is only interested in the increment of pollution, it is not necessary to continue with further data gathering. However, if one is trying to evaluate an airbase's overall impact on an area in comparison to the already existing levels, one would of necessity have to complete this general heading.

Environ sources are subdivided into environ point sources, environ area sources, and environ line sources. The general descriptions for each of these topic areas is almost the same as for the airbase sources covered in the previous section of the guide. Therefore, only major differences will be covered under each specific topic area.

a. Environ Point Sources

The specific point sources being considered under this section require the same basic data acquisition as for airbase point sources, namely:

Coordinates of source center

Stack height

Initial horizontal dispersion parameter

Initial vertical dispersion parameter

Stack exit gas velocity

Stack exit diameter

Building height

Annual emissions of each pollutant emitted in metric tons.

(Each of these terms has been defined previously in section III.2.a, Airbase Point Sources.)

The term environ sources is used to categorize any pollution source that is located outside of the base perimeter. Thus it is assumed that all military sources of pollution have previously been considered.

(1) Instructions and Procedure for Completing Data Sheet 51: Environs-Point Sources

Data sheet 51 will be used to obtain data about the environ point sources considered.

(a) Fill out a data sheet for each point source and specify the type of point source.

(b) Fill in data as for airbase point sources.

b. Environ Area Sources

There are three different methods of collecting data on environ area sources. The method used depends on the information available, so the method is left to the investigator. The three methods and data sheets for each method follows. Only the data sheets for the method used should be completed. Of the three methods, the first one discussed is the most desirable.

The first method is to divide the area sources into stationary and vehicle sources. The data required for stationary area sources is the same as for airbase area sources, namely:

Ground level coordinates of center of area source
Average emission height
Length of side of square area source
Annual emission of pollutants being considered in metric tons

(These terms have been defined previously in III.2.b, Airbase Area Sources.)

The data required for vehicle area sources is the same as for airbase stationary area sources with the following additions:

The type of emission factor
- Hot running
- Cold running
- Combination of hot and cold running

The average route speed within the area source
Number of vehicle miles for each of the six vehicle classes
Number of cold starts

ENVIRON POINT SOURCES

Basic Data

Temperature (o_k)	______
Average Gas Velocity (m/sec)	______
Diameter or Area of Stack (m)	______
Pressure (in H_2O)	______
Height of Stack (m)	______
Height of Building (m)	______
X and Y (UTM) Coordinates	______
Initial Horizontal Dispersion (m)	______
Initial Vertical Dispersion (m)	______

Type of Collection Device

Collection Efficiency
(attach report of test used to determine this)

Type of Air Preheater

Oil Fuel Only (tangentially fired or horizontally fired)

Stack Emissions

Results of Tests (attach results of tests)

Particulates

Grain Loading	Size Analysis	Flow Rate	Annual Emission Rate

SO_2

CO

NO_x

Other

(These terms have been defined previously in III.2.c, Motor Vehicle Sources.) Annual emission in metric tons is not required.

(1) Instructions and Procedure for Completing Data Sheet 52: Environs-Stationary Air Sources

Data sheet 52 will be used to obtain data about stationary environ area sources. The area sources should be divided into square areas and treated in the same way as airbase area sources.

(a) The source type refers to a descriptive name (i.e., Petro-chemical Complex).

(b) Fill out the data as for airbase area sources.

(2) Instructions and Procedure for Completing Data Sheet 53: Environs-Vehicle Sources

Data sheet 53 will be used to obtain data about vehicle environ area sources. Vehicle area sources should be divided into square areas and treated in the same way as airbase vehicle area sources.

(a) Enter the UTM coordinate of the center of area source.

(b) Give the length (in meters) of one side of the area source.

(c) For average speed, give speed limit.

(d) Enter the type of emission factor that best describes the source (hot - 1, cold - 2, combination - 3).

(e) Give the annual mileage driven by each of the six vehicle classes within the area source.

(f) The number of cold starts should be entered if the cold-running emission factor has been designated.

The second method would be used if one does not have reliable data about emission sources outside the base. This method requires the dividing of the surrounding area into square areas (1 km^2). The total area to be divided depends on the degree of coverage desired. However, as a general rule the area within a 15-km radius of the base is sufficient.

Each of these 1-km squares is considered an area source and the basic data requirements for each area source are the same as for other area sources, namely:

Data Sheet 52

ENVIRONS-STATIONARY

AREA SOURCE

Source Type	Emission Height	Length of Side of Source	Annual Emission Rate Metric Tons	Initial Vertical Dispersion	Map Location X	Y

Data Sheet 53

ENVIRONS-VEHICLE

AREA SOURCE

Map Coordinates of Center	Length of Side of Source	Average Speed	Emission Factor	Annaul Vehicle Mileage by Class I	II	III	IV	V	VI	Number of Cold Starts

Coordinates of center of area source
Average emission height
Initial vertical dispersion parameter

(These terms have been defined previously in III.2.b, Airbase Area Sources.)

In addition, data on the type of activity presently taking place in the area in question is necessary.

There are eight basic land-use categories considered in this guide; they are presented in table 7.

Table 7

LAND-USE CATEGORY
(according to Northern Research Classification)

Area category	Sequence number
City Center	1
Urban	2
Suburban	3
Semi-rural	4
Rural	5
Cemetery	6
Park	7
Airport	8

One or more of the land-use categories is assigned to the area under consideration and the total land use is divided fractionally among the different categories. Thus an area source consisting of urban, suburban, and semi-rural land use could have the following:

Sequence number	Fraction of use
2 (Urban area)	0.10
3 (Suburban area)	0.40
4 (Semi-rural area)	0.50

(3) Instructions and Procedure for Completing Data Sheet 54: Environs-General Land Use

This data sheet is to be used for land-use classification of area sources.

Data Sheet 54

ENVIRONS

GENERAL LAND USE

X	Y	LENGTH OF SIDE	Land Use	Fraction of Use

(a) Enter the UTM coordinates of the center of the area source.

(b) Enter the length (in meters) of one side of the square area source.

(c) Give the sequence number or numbers for the general land uses as presented in table 7 and the fractions of use.

The third method for treating area sources is very similar to option 1, but instead of requiring the vehicle information for mobile area sources, only the total annual emission of each pollutant considered (in metric tons) need be supplied. The remaining data requirements as to the source size and location are the same as for option 1.

(4) Instructions and Procedure for Completing Data Sheet 55: Environs-Area Sources

Data sheet 55 will be used to obtain data about environ area sources.

(a) The source type refers to a descriptive name (i.e., Petrochemical Complex).

(b) The emission height is the height from ground level to the point of exhaust discharge.

(c) Length of a side of the square or source should be reported in meters.

(d) The annual emission rate and pollutant type should be reported in metric tons for each pollutant reported.

(e) The column headed Initial Vertical Dispersion Parameter should be completed by giving an estimate (in meters) of the initial vertical displacement of the plume.

(f) Give location in the UTM coordinate system.

c. Environ Line Sources

Environ line sources require the same basic data as civilian vehicle line sources on the airbase and require the same data as other line sources for any additional line sources that might be considered. The basic data requirements are as follows and have been explained previously in III.2.c, Motor Vehicle Sources.

Data Sheet 55

ENVIRONS

AREA SOURCE (GENERAL)

Source Type	Emission Height	Length of Side of Source	Annual Emission Rate Metric Tons	Initial Vertical Dispersion	Map Location X	Map Location Y

Ground level coordinates of one end of line

Width of line

Initial vertical dispersion parameter

Ground level coordinates at opposite end of line

The physical data that has just been presented would probably be most easily obtained from any good road map of the area under consideration.

The additional data that is specific to the source considered is as follows and has also been explained previously.

Average emission height

Emission factors

Hot running

Cold running

Combination of hot and cold running

Average route speed

Vehicle miles per year for each of six vehicle classes

Number of cold starts per year for each of six vehicle classes

(An explanation of these parameters can be found in the subsection on motor vehicles.)

The best estimates for most of these parameters can be obtained from the Highway Department or from the State Police Department. It is not likely that the mileage will be broken down by vehicle classes, but these departments should have an estimate of the fraction of each type of vehicle using the roadway and thus an estimate of the mileage can be obtained. As for the type of emission factor used to describe this source, it would probably be best to assume that hot-running emission factors are most accurate unless specific data can be obtained to indicate otherwise.

(1) Instructions and Procedure for Completing Data Sheet 56: Environ-Mobile Line Sources

Data sheet 56 is to be used to obtain data on environ line sources.

(a) Enter the UTM coordinates for each end of the line segment being considered.

(b) Enter the emission factor that best fits the type of driving.

(c) Enter the speed limit for average speed.

Data Sheet 56

ENVIRON

MOBILE LINE SOURCES

Map Coordinates of Each End	Emission Factor	Average Speed	Mileage By Vehicle Class I	II	III	IV	V	VI	Number of Cold Starts

(d) Provide an estimate of the number of miles driven by each vehicle class on the specific line source.

(e) Provide the number of cold starts, if the cold-running emission factor is being used.

SECTION IV

PROCEDURES FOR HAND CALCULATING EMISSIONS

1. INTRODUCTION

This section is intended to be used to make preliminary emission inventories of specific sources that may be causing trouble at a local level. Before a basic emission inventory can be performed, two different data requirements must be satisfied. First, emission source operational data must be obtained, then specific emission factors must be obtained to apply to the operational data to acquire a quantity representative of the emissions of a process. This first type of data has been the subject of section III. The second, emission factors, are presented in this section along with a suggested procedure for calculating the quantity of the pollutant emitted from some of the primary sources. (At present, the only emission calculation procedure that will be provided is one for obtaining the emission from aircraft at a base. Methods of obtaining emissions from other sources on the base may be obtained from the EPA publications AP-42.)

The quantity of pollutants emitted from aircraft (as with any source) consists of an emission rate multiplied by a period of time over which the source is emitted. Emissions are different for each aircraft type and must be calculated individually. The emissions from an aircraft LTO cycle* are treated as nine separate emissions, each one corresponding to the nine aircraft modes in the LTO cycle (figure 3). The emissions for each mode are then summed to provide an emission for an LTO cycle. This process is repeated for each aircraft type and by multiplying each emission thus obtained by the number of LTOs for that aircraft type for a desired time period, total emissions over the period can be obtained.

The calculation of the tenth mode, touch and go, can be obtained as a combination of the following modes: runway roll, climbout (steps 1 and 2), approach (steps 1 and 2), and landing on the runway.

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*Appendix A contains a detailed description of an aircraft LTO cycle.

To make the calculation of emissions from aircraft less confusing, a detailed procedure is provided along with the values for emission factors (table 8) and for LTO cycle times (tables 9 through 11).

2. PROCEDURE FOR COMPLETING TABLE 12

a. Enter the aircraft and engine type (the engine type can be found in table 2).

b. Enter the type of pollutant being considered.

c. Enter the number of LTO cycles for aircraft type per year or for the time period of interest.

d. Enter the number of engines on the aircraft from table 2.

e. Provide the fuel flow rate for each of the nine modes listed. These can be obtained from the pilot survey sheets (data sheet 6).

f. Obtain from table 8 the emission rate for each pollutant for each fuel flow rate and for the specific engine type.

g. From tables 9 through 11 the average time in mode values for each aircraft type can be obtained. For a specific base, the values obtained from the pilot surveysheets (data sheet 6) can be used when converted from seconds to hours.

h. Total pollution per mode is obtained by multiplying the number of engines times the fuel flow rate times the emission factor times the time in mode.

i. The sum of the values obtained for the nine modes provides a value for one LTO cycle.

j. The one LTO cycle value times the number of LTO cycles provides a value for the total production of pollutant for the time period considered.

k. The above steps are repeated for each aircraft type and summed to give the total amount of the pollutant produced.

l. The whole procedure should be repeated for each pollutant desired.

Table 8

USAF AIRCRAFT ENGINE EMISSION FACTORS

USAF AIRCRAFT ENGINE EMISSION FACTORS

ENGINE MODEL	ENGINE SERIES	AIRCRAFT TYPE	MODE	FUEL FLOW (1000 LB/HR)	POLLUTANT EMISSION RATE (LB/1000 LBS OF FUEL)* CARBON MONOXIDE	UNBURNED HYDROCARBONS	OXIDES OF NITROGEN	TOTAL PARTICULATES**
J-52	PW-3	Hound Dog Missile	IDLE	.93	79.7	22.2	1.8	
			75% THRUST	4.46	9.5	1.0	7.5	
			MILITARY	6.49	2.1	.4	9.5	
J-57	PW-19W	B-52 C-E	IDLE	1.104	58.5	53.4	2.5	8.3
	PW-21	F-100 A-F	APPROACH (75% RPM)	1.709	26.4	12.0	3.6	
	PW-23	F-102 A	MILITARY	9.52	2.0	.7	11.8	12.0
	PW-55	F-101	AFTERBURNER	26.10	31.7	.7	4.4	
			IDLE	1.214	75.3	61.8	1.9	8.3
	PW-43W	B-52 F-G	APPROACH (75% RPM)	1.849	46.1	22.8	3.6	
	PW-59W	KC-135 A	MILITARY	10.612	2.3	.9	15.2	12.0
J-69	T-25	T-37 B	IDLE	.453	106.5	7.9	3.4	
			APPROACH (53% THRUST)	1.052	47.5	.04	5.26	
			MILITARY	1.307	20.6	.02	6.91	
J-75	PW-17	F-106 A-B	IDLE	1.7	76.2	56.86	1.29	.5
	PW-19W	F-105 B-G	APPROACH (_0% THRUST)	11.3	1.4	0.1	11.9	
			MILITARY	13.2	6	0.23	8.2	1.05
			AFTERBURNER	53.7	12.0	0.12	4.1	
J-79	GE-3	F-104 A-B	IDLE	1.121	38.6	9.6	2.4	72.4
	GE-7-7A	F-104 C-D	APPROACH (65% RPM)	2.72	10.1	.8	5.5	
	GE-15	F-4 C-D	MILITARY	9.33	2.3	.03	12.0	4.3
			AFTERBURNER	36.77	13.0	.01	4.6	10.8
			IDLE	1.06	40.1	9.0	2.7	32.4
	GE-17	F-4E	APPROACH (85% RPM)	3.38	7.6	1.7	5.8	
			MILITARY	9.6	1.8	.06	14.8	12.6
			AFTERBURNER	32.0	13.5	.02	5.7	7.2
J-85	GE-5	T-38, F-5	IDLE	.65	156.0	42.0	5.3	
			APPROACH	1.6	58.0	9.4	3.6	
			MILITARY	2.65	38.0	1.3	4.4	
			AFTERBURNER	7.7	21.0	.04	3.0	
TF-30	PW-3,7	F-111 A	IDLE	1.25	68.2	19.4	6.52	26.5
			APPROACH (75% THRUST)	6.65	6.3	2.0	12.0	24.0
			MILITARY	7.12	3.1	.165	26.9	8.38
			AFTERBURNER	38.4	6.39	.014	9.0	29.3
	PW-9	F-111 D	IDLE	1.25	16.4	12.58	6.52	26.5
	PW-100	F-111 F	APPROACH	6.65	16.0	2.0	12.0	24.0
			MILITARY	7.12	3.0	1.2	19.7	8.38
			AFTERBURNER	40.38	24.8	2.0	4.47	5.36
TF-33	PW-3	B-52 H	IDLE	.846	93.33	103.92	2.02	
	PW-5	C-135 B-U	APPROACH	3.797	8.99	3.79	7.30	
			MILITARY	9.979	.41	.11	14.13	
TF-34	GE-100	A-10	IDLE	.365	114.0	10.3	3.7	
			APPROACH	1.298	15.0	0.6	7.7	
			MILITARY	3.532	0.6	0.2	12.6	

Footnotes:

[1] Aircraft Engine Emission Catalog, AESO 101-74-1, Navy Environmental Protection Data Base, North Island, CA, March 1974.

[2] Data from Nature and Control of Aircraft Engine Exhaust Emissions; Northern Research and Engineering Corporation. Report No. 1134-1. Eng. A - JT3C. Data does not specify whether soluble particulates are included or not.

[3] Exhaust Emission Measurements on Teledyne CAE Turbojet Engines, CAE TN 717-71-09-02, August 1971.

[4] Robson, F. L., Kesten, A. S. and Lessard, R. D.: Analysis of Jet Engine Test Cell Pollution Abatement Methods. AFWL-TR-73-18.

[5] Blazowski, William S., Personal Correspondence using recent data collected under AFAPL Contract F33615-73-C-2047 with the General Electric Company, 20 September 1974.

*Sulfur emissions are 1.0 lbs/1000 lbs fuel for all turbine engines using JP-4 fuel.

**A Particulate measurement technique has not yet been standardized. These values include all condensable particulates and are far higher than solid particulates alone.

[6] Author's estimate based on data in references 1 and 5.

[7] Lazalier, G. R. and Gearhart, J. W.: Measurement of Pollutant Emissions From an Afterburning Turbojet Engine at Ground Level, AEDC-TR-72-70, August 1972.

[8] Data from Burnett, R. D.: Noise and Pollution Emissions from Noise Supressors for Engine Test Stands and Aircraft Power Check Pads, Report 71M-19 January, 1972, USAF Environmental Health Laboratory.

[9] Bogdan, Leonard and McAdams, H. T.: Analysis of Exhaust Emission Measurements CAL Report No. NA-5007-K-1: October 15, 1971.

[10] Personal telephone communication from Lt. Roth (ASD) to Capt Naugle (AFWL) on 17 Dec 74 based on most recent A-10 System Program Office data.

Table 8 (cont'd)

ENGINE MODEL	ENGINE SERIES	AIRCRAFT TYPE	MODE	FUEL FLOW (1000 LB/HR)	POLLUTANT EMISSION RATE (LB/1000 LBS OF FUEL)* CARBON MONOXIDE	UNBURNED HYDROCARBONS	OXIDES OF NITROGEN	TOTAL PARTICULATES*
TF-39	GE-1	C-5	IDLE	1.13	50.0[11]	15.0[11]	3.5[11]	0.3[11] (Dry
			APPROACH	5.74	3.0[11]	0.3[11]	25.0[11]	1.4[11] Particles
			MILITARY	11.41	0.5[11]	0.1[11]	38.0[11]	1.5[11] Only)
	GE-1 (low smoke)	C-5	IDLE	1.13	50.0[11]	15.0[11]	3.5[11]	0.04[11]
			APPROACH	5.74	3.0[11]	0.3[11]	28.0[11]	0.07[11]
			MILITARY	11.41	0.5[11]	0.1[11]	40.0[11]	0.04[11]
TF-41	A-1	A-7	IDLE	1.07	107.1[1]	66.2[1]	1.3[1]	
			APPROACH (62% THRUST)	5.31	5.2[1]	2.4[1]	10.6[1]	
			MILITARY	9.04	1.6[1]	0.6[1]	22.3[1]	
F-100	PW-100	F-15	IDLE	1.06	19.3[12]	2.3[12]	4.0[12]	.11[12] (Dry
			APPROACH	3.0	3.0[12]	.6[12]	11.0[12]	.33[12] Particles
			MILITARY	10.04	1.8[12]	.05[12]	44.0[12]	.83[12] Only)
			AFTERBURNER	44.2	55.0[12]	.1[12]	16.5[12]	0.0[12]
F-101	GE-100	B-1	IDLE	Not for public release	17.2[13]	.9[13]	4.2[13]	.044[13]
			APPROACH		3.2[13]	.3[13]	8.2[13]	.045[13]
			MILITARY		.5[13]	.2[13]	23.9[13]	.05[13]
			AFTERBURNER		65.0[13]	1.0[13]	8.0[13]	.052[13]
T-56	A-7	C-130 B,E,F	IDLE	.548	28.10[9]	11.92[9]	3.93[9]	
			APPROACH	1.053	3.48[9]	.94[9]	7.38[9]	
			MILITARY	2.079	1.04[9]	.21[9]	10.98[9]	
	A-15	C-130 H	IDLE	.493	18.05[9]	15.05[9]	2.45[9]	
			APPROACH	1.145	3.04[9]	.29[9]	6.38[9]	
			MILITARY	2.392	1.56[9]	.18[9]	11.66[9]	
O-470	C	O-1 A	IDLE	.01512	742.5[9]	191.4[9]	1.0[9]	
			APPROACH	.08555	691.7[9]	9.5[9]	9.4[9]	
			MILITARY	.13125	1155.8[9]	20.4[9]	1.1[9]	
IO-360	C	O-2 AB	IDLE	.01517	848.2[9]	144.5[9]	1.1[9]	
			APPROACH	.06788	972.0[9]	17.4[9]	6.6[9]	
			MILITARY	.0887	1031.3[9]	22.5[9]	5.3[9]	

Footnotes:

[11]Bahr, D. W., General Electric Aircraft Engine Group (GEAEG) Personal correspondence to Capt W. S. Blazowski, Air Force APL, August 16, 1973 and Mr. T. Lyon, GEAEG, personal telcon to Capt D. F. Naugle, 11 October 1974.

[12]Orthman, Colonel Harry, F-15 SPO, ASD/YF, Personal correspondence to AFWL using ASD/YFEJ adjustments to measured data in an Arnold Research Organization Inc. letter report dated 7 September 1973.

*Average sulfur emissions are 1.0 lb/1000 lbs fuel for turbine engines using JP-4 fuel and 0.6 lb/1000 lbs fuel for piston engines using "aviation gasoline."

*A Particulate measurement technique has not yet been standardized. These values do not include condensable particulates and are far lower than total particulates.

[13]Updated Final Environmental Statement for B-1 Aircraft Development, Dept of the Air Force, AF-ES-71-2F(1), October 1973.

Table 9

SUMMARY OF FIGHTER LTO CYCLE TIMES

(Time in minutes)

Aircraft mode	F-4	F-100	F-104	F-105	F-111
1. Idle at startup	6.4	6.1	5.0	6.1	6.2
2. Taxi before takeoff*	12.1 (6.0)	13.0 (7.0)	14.0 (7.0)	9.8 (5.4)	9.4 (5.0)
3. Engine check at runway end	0.8	0.6	0.8	0.8	1.4
4. Runway roll	0.3	0.4	0.4	0.5	0.4
5. Climbout					
a. Step No. 1	0.4	0.6	0.4	0.5	0.4
b. Step No. 2 (to 3000° AGL)	0.3	0.5	0.3	0.4	0.3
6. Approach					
a. Step No. 1** (from 3000° AGL)	1.9	1.9	1.7	1.7	1.9
b. Step No. 2	0.7	0.7	0.4	0.5	0.7
7. Landing on runway	1.1	1.2	1.0	1.2	1.1
8. Taxi after landing***	9.7 (6.0)	12.0 (7.0)	12.0 (7.0)	10.0 (5.5)	9.0 (5.0)
9. Idle at shutdown	0.4	1.0	0.5	0.8	1.3
Total	34.1	37.8	36.7	32.3	32.3

*Numbers in parentheses are the times for weapons arming.
**Estimated times for "straight-in" approaches.
***Numbers in parentheses are the times for weapons de-arming.

Table 10

SUMMARY OF CARGO AND BOMBER LTO CYCLE TIMES

(Time in minutes)

Aircraft mode	C-5	C-9	C-118	C-130	KC-135	C-141	B-52
1. Idle at startup	3.0	3.2	3.2	2.8	20.0	2.0	20.0
2. Taxi before takeoff	7.4	7.7	4.8	6.6	9.5	4.7	9.0
3. Engine check at runway end	0.1	0.1	0.1	0.1	2.5	0.1	4.5
4. Runway roll	0.4	0.5	0.5	0.5	0.7	0.3	0.7
5. Climbout							
a. Step No. 1	0.5	0.6	0.7	0.7	0.7	0.4	0.7
b. Step No. 2 (to 3000° AGL)	0.5	0.5	1.1	0.7	1.0	0.4	0.8
6. Approach							
a. Step No. 1 (from 3000° AGL)	2.5	2.5	2.8	2.5	3.2	1.9	3.0
b. Step No. 2	1.5	1.5	1.5	1.5	0.8	1.5	1.0
7. Landing on runway	2.0	0.7	0.6	0.9	1.4	1.4	1.0
8. Taxi after landing	7.5	2.4	5.3	3.0	8.4	4.9	12.0
9. Idle at shutdown	2.0	0.3	0.3	0.7	4.5	7.3	4.8
Total	27.9	20.0	19.7	20.0	52.6	25.5	57.6

Table 11

SUMMARY OF TRAINER LTO CYCLE TIMES

(Time in minutes)

Aircraft mode	T-29	T-33	T-37	T-38	T-39
1. Idle at startup	2.5	2.5	3.8	5.2	2.3
2. Taxi before takeoff	5.0	4.6	7.7	8.0	3.8
3. Engine check at runway end	0.1	0.3	0.5	0.3	0.1
4. Runway roll	0.4	0.5	0.5	0.3	0.4
5. Climbout					
a. Step No. 1	0.8	0.5	0.5	0.3	0.6
b. Step No. 2 (to 3000°AGL)	1.1	1.0	0.5	0.5	0.7
6. Approach					
a. Step No. 1* (from 3000° AGL)	2.8	1.9	2.2	2.1	1.7
b. Step No. 2*	1.5	1.6	0.5	0.3	0.6
7. Landing on runway	0.9	1.1	1.3	1.1	1.0
8. Taxi after landing	3.0	4.0	5.7	5.8	4.0
9. Idle at shutdown	0.5	0.4	0.6	0.7	0.3
Total	15.8	16.5	23.7	24.7	14.9

*Estimated times for "straight-in" approaches.

Table 12

AIRCRAFT EMISSIONS--HAND CALCULATION SETS

AIRCRAFT TYPE ____________ ENGINE TYPE ____________ NUMBER OF LTO CYCLES ____________ POLLUTANT ____________

MODE	NUMBER OF ENGINES	FUEL FLOW 1000 lb/hr	EMISSION FACTOR lb/1000 lb FUEL	TIME IN MODE hr	TOTAL POLLUTION PER MODE lb/MODE	TOTAL POLLUTION/YR/LTO CYCLE lbs
1. IDLE AT START UP						
2. TAXI BEFORE TAKEOFF						
3. ENGINE CHECK AT RUNWAY END						
4. RUNWAY ROLL						
5. a. CLIMBOUT TO 3000' AGL-STEP 1						
5. b. " " " " " 2						
6. a. APPROACH FROM 3000' AGL-STEP 1						
6. b. " " " " " 2						
7. LANDING ON THE RUNWAY						
8. TAXI AFTER LANDING						
9. IDLE AT SHUTDOWN						
TOTAL EMISSION PER CYCLE	—	—	—	—		

SECTION V

PROCEDURE FOR AQAM DATA REDUCTION

This section provides a transition between the actual data gathering operation and coding the data for use in the Air Quality Assessment Model. The majority of the data gathered in section III has to be manipulated into proper form for coding. The complete details of how the data is to be placed on the actual computer cards is provided in a companion document entitled "A Generalized Air Quality Assessment Model for Air Force Operations - An Operator's Guide" (AFWL-TR-74-54). This section must be used in conjunction with the Operator's Guide.

The present manual in its description and data reduction follows the same data sets as does the Operator's Guide; therefore, the transferral of data from this section to the actual coding forms should pose little difficulty. The data sets considered in the following portions follow the headings given in table 13.

1. DATA SECTION 5

The following method will be used to reduce the data. First, the Operator's Guide data set number will be given and then the location of the data in this report that corresponds to it will be given.

a. Data Set 5A

Data set 5A consists of four pieces of data.

(1) Number of aircraft types

(2) Number of runways used

(3) Number of aircraft parking areas

(4) Number of special runway use cases

For most of this data no further reduction is required.

The number of aircraft types can be obtained directly from data sheet 1. All that must be done is sum the aircraft types given in the first column.

The number of runways used can be obtained directly from data sheet 5.

Table 13

SOURCE INVENTORY INPUT DATA SETS
(Taken from AFWL-TR-74-54)

Data Set No.	Data description
5*	Aircraft emission inventory
5.A	Number of aircraft types et al.
5.B	Aircraft identification and activity
5.C	Aircraft parking areas
5.D	Runway specific information
5.D.1	Runway geometry
5.D.2	Runway - wind direction use
5.D.3	Runway - aircraft use
5.D.4	Runway - taxiway number
5.D.5.1	Runway - inbound taxiway use
5.D.5.2	Runway - inbound taxiway segments
5.D.6.1	Runway - outbound taxiway use
5.D.6.2	Runway - outbound taxiway segments
5.E	Arrival service vehicle emissions
5.F	Departure service vehicle emissions
5.G	Refueling of aircraft
5.H	Spillage during refueling operations
5.I.1 and 2	Fuel venting emissions
6*	Airbase source inventory
6.A	Training fires
6.B	Test cells
6.C	Run-up stands
6.D	Airbase power plants
6.E	Airbase incinerators
6.F	Airbase storage tanks
6.G	Other airbase point sources
7*	Airbase area sources
7.A	Airbase area source geometries
7.B	Hydrocarbon working loss
7.C	Hydrocarbon breathing losses - storage tanks
7.D	Tank truck hydrocarbon breathing losses
7.E	Military and civilian vehicle hydrocarbon breathing losses

Table 13 (cont'd)

Data Set No.	Data description
7.F	Other evaporative hydrocarbon sources
7.G	Space heating sources
7.H	Off-road vehicle sources
7.I	Military vehicle area sources
7.J	Civilian vehicle area sources
8*	Airbase line sources (nonaircraft)
8.A	Airbase line source geometries
8.B	Airbase military vehicle line activity
8.C	Airbase civilian vehicle line activity
8.D	Other airbase line activity
9*	Environ source data
9.A	Environ point sources
9.B	Environ area sources
9.C	Environ line sources
9*	Airbase source inventory

*Asterisked numbers require no actual input from user.

The number of aircraft parking areas can be obtained from the base map (data sheet 9) used to record the various parking areas of the assigned and transient aircraft. Also, the data should correspond to the data reported on data sheet 10.

The number of special runway cases can be obtained from data sheet 5.

b. Data Set 5B

This data set deals with the number of arrivals, departures, and touch-and-go's for each aircraft type using the base (see data sheet 1).

c. Data Set 5C

This data set deals with describing exactly each of the parking areas on the base. The following procedure is to be used on each parking area that was described on the base map.

Place the mylar overlay on the base map (the overlay obtained from the base drafting department which was set up with a grid such that the squares of the grid are not more than 0.1 km or 100 m on a side with an overall scale which corresponds to that of the base map in question).

(1) Divide the parking area into squares. This operation should be as exact as possible without giving rise to an excessive number of squares (a maximum of 10 squares per parking area is allowed).

(2) Indicate the following columns on a piece of graph paper (ID, NPASA, X, Y, L). ID stands for parking area identification number; NPASA refers to the number of squares making up the parking area; X and Y are the UTM coordinates of the center of each square making up the area; and L is the length of a side of the square in meters.

The above two steps should be repeated for each of the parking areas determined on the base map.

d. Data Set 5D

This data set is concerned with a detailed description of the runways. Repeat data set 5D for each runway.

The coordinates X and Y for the runway in kilometers can be obtained from data sheet 5 and from the base map using the UTM coordinate system. The runway vector angle can be obtained from data sheet 5 or from the base map.

Runway length can also be obtained from data sheet 5 and should be in kilometers. Use of default values for initial horizontal and vertical dispersion is highly recomended.

Data for runway-wind direction use can be obtained from data sheet 5. The only conversion involved is determining which 22.5° sector the specific limiting wind condition applies to. (For air pollution purposes, the common compass has been divided into 16 sectors of 22.5° each. They are numbered sequentially clockwise, thus wind from 15° would be in sector 1.)

Aircraft arrival data can be obtained from data sheet 5, Runway Usage. The figure is reported in terms of percent of operations. The total operation of each aircraft in the base inventory times the percent of operations on a specific runway will give the number of operations for the runway. This number is then divided by 2 to obtain the number of arrivals.

Aircraft departure data is the same as for aircraft arrivals, unless any limitations are reported on data sheet 5 for a specific runway.

The next portion of data set 5D covers the taxiways that are used by both inbound and outbound aircraft for the runway under consideration.

The taxiway paths are defined by straight line segments from the end of the runway to the center of the parking area where the aircraft type is normally parked. The data under this section consist of the runway identification, number of inbound taxiways, number of outbound taxiways, fraction of aircraft using the specific taxiway, and the taxiway path geometries.

The total number of inbound and outbound taxiways for each runway can be obtained from data sheet 12 and from the base map (data sheet 11). The fraction of each type of aircraft using the specific taxiway can be obtained from the runway use data and from the number of taxiways used by that aircraft type to get to the various parking areas assigned to it. In most instances, if there is one parking area for F-4s, it should have one taxiway path to and from the runway used; in this instance, the fractional use would be 1.

The inbound taxiway path geometries can best be obtained from the base map using the mylar overlay. The path is to consist of straight line segments from the end of the runway to the center of the parking area used by each aircraft type in the base inventory and by transient aircraft to the transient area. This same procedure should be followed for outbound taxipath data.

e. Data Sets 5E and 5F

Data sets 5E and 5F are used to describe the emission from aerospace ground equipment for arriving and departing aircraft. The emissions are considered to be the same for both arriving and departing aircraft since they usually take place in the same parking area and, in general, data on possible differences has not been available.

The basic data for this set comes from data sheets 17, 18, and 19. For each aircraft in the base inventory, add the hours of operation under each heading to obtain the total hours of gasoline-powered AGE usage and JP-4-powered AGE usage. From these totals calculate the total emissions due to AGE operation. Also for these calculations, the total quantities of JP-4 and MoGas used by AGE for a year are required. The calculation in step-by-step form is as follows:

GALLJP = total gallons of JP-4 consumed by AGE

GALLMO = total gallons of MoGas consumed by AGE

ACTCL = number of arrivals and departures (one LTO cycle) for each aircraft type

JP-4HRC = number of JP-4-powered AGE hours used for one LTO for each aircraft type

MOGHRC = number of MoGas-powered AGE hours used for one LTO for each aircraft type

JP-4HR = total hours of JP-4-powered AGE used per year for each aircraft type

JP-4HR = ACYCL *JP-4HC

MOGHR = total hours of MoGas-powered AGE used per year for each aircraft type

MOGHR = ACYCL *MOGHRC

TAGEJP = total JP-4-powered AGE hours from all aircraft

TAGEMO = total MoGas-powered AGE hours from all aircraft

AGEJP-4 = gallons of JP-4 used per aircraft cycle for each aircraft type

AGEJP-4 = GALLJP*(JP4HR/TAGEJP)/ACYCL

AFEMOG = gallons of MoGas used per aircraft cycle for each aircraft type

AGEMOG = GALLMO*(MOGHR/TAGEMO)/ACYCL

Calculation of the pollutant emission in terms of kg per LTO:

CO = carbon monoxide

HG = hydrocarbons

NO = nitrogen oxides

P_T = particulates

SO = sulfur oxides

From JP-4-powered vehicles:

CO = AGEJP-4*2.933*20./1000

HC = AGEJP-4*2.933*2.0/1000

NO = AGEJP-4*2.933*4.0/1000

P_T = AGEJP-4*2.933*20./100

SO = AGEJP-4*2.933*.4/1000

From MoGas-powered vehicles:

CO = AGEMOG*2.623*917./1000

HC = AGEMOG*2.623*53.7/1000

NO = AGEMOG*2.623*2.77/1000

P_T = AGEMOG*2.623*6.42/1000

SO = AGEMOG*2.623*0.61/1000

Each of the above must be divided by 2 to obtain the quantity per departure or arrival.

f. Data Set 5G

This data set is concerned with the refueling of aircraft. The basic data on average refueling are reported on data sheet 22. This value must be converted to liters for input to the computer model. If a value was not reported on data sheet 20 for each aircraft considered, the best way to proceed is to use a value of 80 percent of the fuel capacity of the aircraft under consideration.

g. Data Set 5H

This data set deals with determining the quantity of fuel vented from arriving or departing aircraft (data sheet 23). The data is reported in liters and can be considered to be in liter per engine for each operation (one takeoff and one landing).

2. DATA SECTION 6

The following portion of this guide corresponds to Airbase Point Sources.

a. Data Set 6A

This data set deals with training fire sources. Further data reduction for this source should not be required except for the adding of monthly fires from data sheet 24 to obtain a total value. The location for the training fire pit should be obtained from the base map using the UTM coordinate system.

b. Data Set 6B

Data set 6B deals with vertical exhaust turbine engine test facilities. The data gathered on data sheets 25 and 26 should not have to be converted for use as an input for this section. The location of the test cell or cells should be obtained from the base map using the UTM coordinate system.

c. Data Set 6C

Data set 6C deals with the second type of turbine engine test facilities, mainly run-up stands (run-up stands have a horizontal exhaust).

As with test cells, the data on data sheet 25 should not have to be converted to any degree for use as an input for this section. The location of the various run-up stands should be obtained from the base map using the UTM coordinate system.

d. Data Set 6D

Data set 6D deals with airbase power plants. The data for this section can be obtained from data sheets 27 and 28. The only changes that might be required would be conversion of units if the data were not originally gathered in the units specified in the computer program. The location of the power plant or plants should be obtained from the base map using the UTM coordinate system.

e. Data Set 6E

Data set 6E deals with the various types of incinerators that may be located on the base. The point source data should already be in the proper units and can be obtained from data sheets 29 and 30. The charging rate can be determined from the number of charges per day and the average weight of the charge. As before, the location of the incinerator or incinerators should be obtained from the base map using the building number and employing the UTM coordinate system.

f. Data Set 6F

Data set 6F deals with petroleum storage tanks as point sources. The data that was gathered on data sheet 31 is sufficient to supply all of the required parameters for this section. The units may have to be converted for this data set as they have been for others in the point source category. The location of the storage tanks should be obtained from the base map using the UTM coordinate system.

g. Data Set 6G

Data set 6G is the catch-all data set that is used to describe any point source that does not fit into one of the specific data sets already covered. The only possible conversion for this data set would be the annual emission rate for each pollutant if the conversion has not already been made on data sheet 22. All of the necessary stack parameters should be reported on data sheet 33. As with all of the other point sources in this general data section, the X and Y coordinates should be given in terms of the UTM coordinates as presented on the mylar overlay on the base map.

3. DATA SECTION 7

The following section of the guide corresponds to Airbase Area Sources.

a. Data Set 7A

The first data set in this section is a compilation of physical area source data. The data is recorded on copies of data sheet 34 which were filled out for each source.

b. Data Set 7B

The first emission source heading in this data set 7B deals with hydrocarbon filling working losses and spillages that might occur in areas other than aircraft parking areas. The data for this section is reported on data sheets 35 and 36. The data on these sheets will generally be in the form of gallons per year. This has to be converted to kiloliters.

c. Data Set 7C

Data set 7C is concerned with hydrocarbon breathing losses from petroleum storage tanks. The data for this section (data sheet 37) is in exactly the same form as that for storage tank point sources. The major portion of the data reduction is conversion of units.

d. Data Set 7D

Data set 7D deals with the parking areas used by the tank trucks. The data for this section can be obtained from data sheet 38 with merely conversion of units.

e. Data Set 7E

This data set deals with the civilian and military parking areas on the base. The data for this section can be found on data sheet 39. Gas tank capacity is determined by multiplying each vehicle type's gas tank capacity by the percent of that vehicle type in the source and by summing these values. Average fraction of tank filled should be 1/2 unless other data is available. Convert tank capacity to liters.

f. Data Set 7F

This data set is the catch-all data set and it is difficult to specifically describe the data reduction procedure, but for any source that falls into this category, the following must be supplied: the annual emission rate in metric tons, the X, Y, UTM coordinates for each square making up the area source, and length of side of the square. The data can be found on data sheets 38 and 39.

g. Data Set 7G

This data set is to be used for all space-heating area sources on the base. The basic data for this section should be recorded on data sheet 42. The specific conversion and/or data reduction procedure to be used is dependent on the type of fuel used and the size of the furnace or furnaces within the area source. The units required can be obtained from table 9. For example, if natural gas is being consumed by the domestic heating unit, table 7 would indicate that the natural gas consumption should be reported in 10^6 cubic meters (GAS). Thus, one would take the consumption figures of natural gas from data sheet 42 for the entire area under consideration and convert this to 10^6 cubic meters.

h. Data Set 7H

The required data for this set can be obtained from data sheet 43 Class VI and from data sheet 44. The numbers of 43 Class VI will give the total miles that are driven by each year vehicle on the base. The information on

data sheet 44 should provide the distribution of the mileage driven on the base by Class VI vehicles. The coordinates of the center of each area and the length of a side of each source can then be obtained from the base map using the mylar overlay. The only other data needed is the quantity of diesel fuel consumed in each area source. This can be calculated by assuming that the average fuel consumption for diesel vehicles is about 0.33 gallon per mile. Thus, by using this factor times the number of miles driven, an estimate can be obtained for the annual diesel consumption for each area.

i. Data Set 7I

The required data for this data set can be obtained from data sheet 43 Class I through V and from data sheet 44. The coordinates of the center of each area and the length of a side of each area source can be obtained by using the designation from data sheet 44 and the base map on which the designation is recorded. The data on mileage, emission factor, and route speed should be obtained from data sheet 44. Reference is made to data sheets 43, Class I through V, which are to be used to check the total mileage figure given for each vehicle.

j. Data Set 7J

The required data for this data set can be obtained from data sheets 46 and 47. The basic data requirements are the same as for military vehicle area sources, namely, the number of miles driven in each area source, the emission factor that best describes the type of driving, the average route speed, and the number of cold starts.

4. DATA SECTION 8

a. Data set 8A

The first data set in this section, data set 8A, is a compilation of line source data. The data required for this section and how it can be obtained are discussed along with each of the line source types considered.

b. Data Set 8B

The required data for this set can be obtained from data sheet 43, from data sheet 44, and from the base map used to determine the location of the various roadways. The majority of these roadways must be subdivided and represented as straight line segments. The coordinates of both ends of each

straight segment of the line source is obtained from the base map using the UTM coordinate system. A good estimate for the average emission height for a roadway would probably be between 1 and 3 meters, depending on the vehicle class distribution using the segment of roadway in question. A good estimate for the initial vertical dispersion parameter would be between 3 and 5 meters, depending again on the vehicle class distribution. The required data on mileage. type of emission factor, and route speed should be obtained directly from data sheet 44. Reference is made to data sheet 43 which is used to check the total mileage figure given by each vehicle class.

c. Data Set 8C

The data requirements are the same for this data set as for data set 8B, Military Line Sources, except civilian vehicles are dealt with in this data set. The required data can be obtained from the base map and from data sheets 46 and 47.

d. Data Set 8D

The data required for this set consist of the same physical information about the line source as required for military and civilian vehicle line sources, but instead of entering the mileage traveled or the type of source, enter only the annual emission rate of each pollutant emitted by the source. As indicated in the data gathering section, the only source that is specifically considered under this heading is locomotives. The annual emission rate for each pollutant from a locomotive can be calculated by the following procedure. From the total number of gallons of fuel used per year (data sheet 50), calculate the pollutant emission rates by employing the emission factors found in table 14. After obtaining the pollutant emission rate, distribute the total amount to the various railbeds (line sources) by the percentage use figure given on data sheet 50.

5. DATA SECTION 9

a. Data Set 9A

The required data for this set can be obtained from data sheet 51, one of which was completed for each point source considered. The data contained on the data sheets can be used directly as long as the data was reported in the required units; otherwise, the units have to be converted.

b. Data Set 9B

The type of data reduction procedure required for this data set is dependent on the option chosen, and in most instances, the data reduction should consist only of unit conversions; refer to data sheets 52 through 55.

c. Data Set 9C

The required data for this set can be obtained from data sheet 56 and, if the data was reported in the proper format, no additional data reduction should be required.

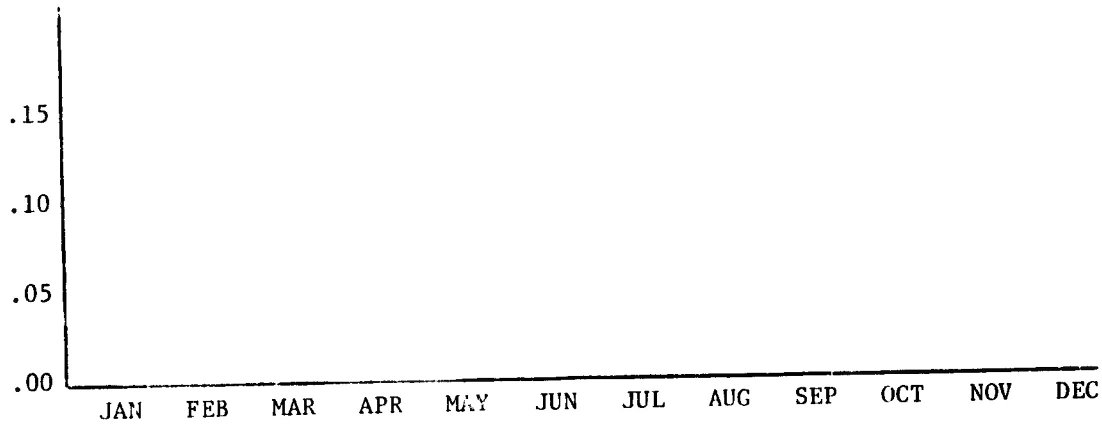
Table 14

EMISSION FACTORS FOR LOCOMOTIVES
(Taken from AP-42)

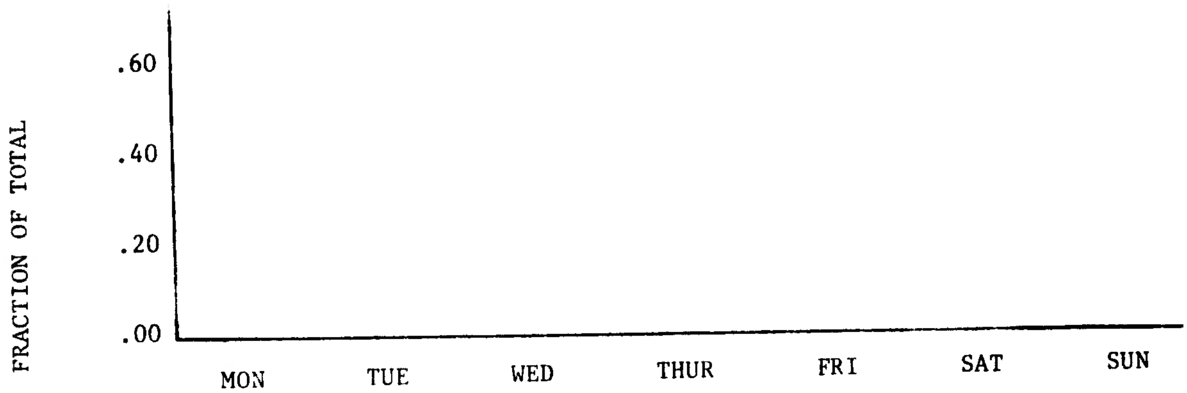
Pollutant	$lb/10^3$ gal	$kg/10^3$ lit
Particulates	25	3.0
Oxides of sulfur (SO_x as SO_2)[d]	65	7.8
Carbon monoxide	70	8.4
Hydrocarbons	50	6.0
Oxides of nitrogen (NO_x as NO_2)	75	9.0
Aldehydes (as HCHO)	4	0.48
Organic acids	7	0.84

One additional form, data sheet 57 is supplied for the activity fractions of all sources and may be helpful in the data reduction process.

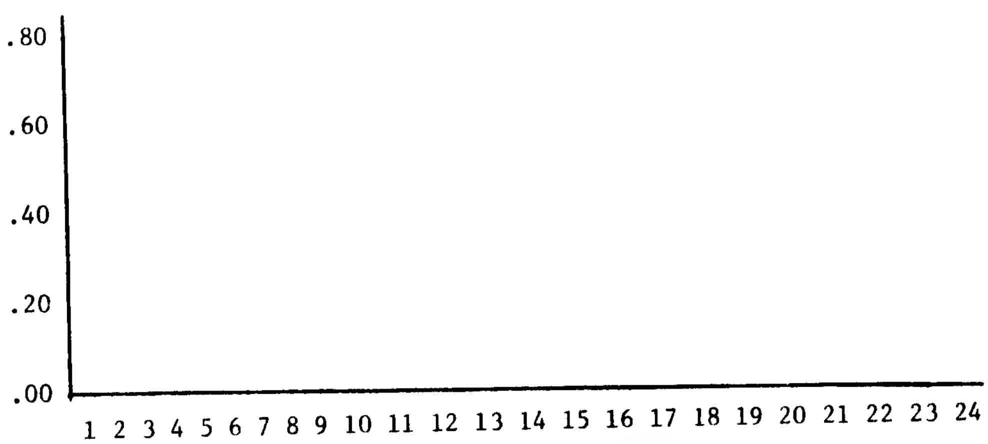
Data Sheet 57



MONTHLY ACTIVITY FRACTIONS



WEEKLY ACTIVITY FRACTIONS



HOURLY ACTIVITY FRACTIONS

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APPENDIX A

DETAILED DESCRIPTION OF AIRCRAFT LANDING AND TAKEOFF CYCLE

This appendix gives an indication of the type and degree of data required to calculate the amount of atmospheric pollutants emitted by one aircraft in one LTO cycle.

Individual aircraft LTO modes are illustrated in figure 3. A list of the modes and their definitions is as follows:

1. Idle at startup - the time of first engine turn-on until beginning of taxi.
2. Taxi before takeoff - the time of initial movement on the parking ramp until engine check at the runway end.
3. Engine check at runway end - most aircraft have an engine check at an elevated thrust setting before takeoff.
4. Runway roll - the time of forward start of aircraft for takeoff until its back wheels leave the runway.

5\. a. Climbout step 1 - to 3000 feet - most of the aircraft with a two-part climbout have afterburners. Any sharp change in engine operating mode or aircraft angle necessitates a two-step climbout.

5\. b. Climbout step 2 - the remaining part of the climbout to 3000 feet.

6\. a. Approach step 1 - the approach to 1000 feet from 3000 feet or to landing on the runway, depending on type of aircraft.

6\. b. Approach step 2 - from 1000 feet to the runway on straight-in landings and from the head of the runway to a completion of a pitch-out pattern on an initial run over the field to runway set down.

7. Landing on runway - the time the aircraft touches down on the runway until it turns off on a taxiway.
8. Taxi after landing - the time the aircraft is on the taxiway until it parks.
9. Idle at shutdown - the time the engines are operating after taxi until they are shut off.

The specific data required for calculation of each of the times for the nine LTO cycle modes are described under the individual modes.

1. IDLE AT STARTUP MODE

a. Time in Mode

The time for this mode will be a constant for each of the 33 aircraft types that will be considered. The numerical value for this operational parameter will be obtained from a survey of pilots who fly the specific aircraft type. The time factor will appear in the algorithm used to calculate the emission rate for this mode of the LTO cycle.

b. Location

The location for this mode will be an x, y coordinate value for each aircraft type. This data will be obtained from the base map and from a survey of base personnel associated with aircraft operations.

c. Emission Factor

The emission factor for each power setting will be given in terms of pounds of pollutant per 1000 pounds of fuel. This value will be specified for each type of engine in the Air Force inventory. These values are presented in table 8.

d. Fuel Flow Rate

The fuel flow rate in terms of 1000 lb/hr for each engine and mode. These values are also presented in table 8.

e. Wind Direction

The values for wind direction will be obtained from the ETAC Weather Information Service and modified to specific program requirements by the Air Force.

f. Taxi Speed in Miles Per Hour

Taxi speed value will be obtained from a survey of pilots and personnel who are familiar with aircraft operations (data sheet 6).

2. ENGINE CHECK MODE

a. Time in Mode

The time for this mode will be a constant for each of the 33 aircraft types that will be considered. The numerical value for this operational parameter will be obtained from a survey of pilots who fly the specific aircraft type. The time factor will appear in the algorithm used to calculate the emission rate for this mode of the LTO cycle.

b. Location

This will be specified by the wind direction (which in turn will specify the runway to be used). The specific location will be at the end of the runway (obtained from the base map).

c. Emission Factor

The emission factor for each power setting will be given in terms of pounds of pollutant per 1000 pounds of fuel. These values are presented in table 8.

d. Fuel Flow rate

The fuel flow rate in terms of 1000 lb/hr for each engine and mode. These values are also presented in table 11.

3. RUNWAY ROLL MODE

a. Algorithms have been developed to calculate these values and are presented in a report entitled, "USAF Aircraft Takeoff Length Distances and Climbout Profiles."

b. Location (Wind Direction)

This will be specified by the wind direction (which in turn will specify the runway to be used). The specific location will be at the end of the runway (obtained from the base map).

c. Emission Factor

The emission factor for each power setting will be given in terms of pounds of pollutant per 1000 pounds of fuel. These values are presented in table 8.

d. Fuel Flow Rate

The fuel flow rate in terms of 1000 lb/hr for each engine and mode. These values are also presented in table 8.

e. Pressure Altitude

This parameter will be obtained from a survey of base operational personnel and/or the pilot survey.

f. Temperature

This parameter will be obtained from ETAC.

g. Aircraft Load

For operations at an individual base, an average percentage of the maximum takeoff weight will be determined from a survey of the pilots and/or base personnel and will be used in the calculations of runway roll.

h. Aircraft Takeoff Speed

Values for the takeoff speed of the 33 aircraft types will be obtained from design specifications and from information gained by the pilot survey.

i. Aircraft Takeoff Length

This parameter will be calculated by the runway roll algorithm. Also, data from the runway roll length will be checked against pilot surveys to determine if the calculated value corresponds to that used in every day operation.

4. CLIMBOUT MODE

a. Time in Mode

The data necessary for calculation of time in mode will be obtained from aircraft specifications and from pilot surveys. The specific parameters used in this calculation are takeoff speed, aircraft acceleration, afterburner shutoff altitude, climb angle, and cruise speed--all of which are treated individually in subsequent paragraphs.

b. Location

This will be specified by the wind direction (which in turn will specify the runway to be used). The specific location will be at the end of the runway (obtained from the base map).

c. Emission Factor

The emission factor for each power setting will be given in terms of pounds of pollutant per 1000 pounds of fuel. These values are presented in table 11.

d. Fuel Flow Rate

The fuel flow rate in terms of 1000 lb/hr for each engine and mode. These values are also presented in table 8.

e. Climb Angle

Specific climb angles for each aircraft type will be calculated from a correlation of aircraft weight and maximum and minimum climb angles obtained from the 1-1 Flight Manuals. These maximum and minimum angles will be modified by information obtained from pilot surveys at the individual base to give the calculated value and input as a percentage of either the maximum or minimum. In some cases, the climb angle may be specified by base operations and in this situation, the survey of the pilots would so indicate.

f. Afterburner Shutoff

The use of an afterburner for takeoff and the altitude at which it is shutoff will be determined by pilot survey and by the survey of base operations personnel.

g. Aircraft Takeoff Speed

Values for the takeoff speed of the 33 aircraft types will be obtained from design specifications and from information gained by the pilot survey.

h. Cruise Speed

This data will be obtained from aircraft specifications and pilot survey.

5. APPROACH MODE

a. Time in Mode

The data necessary for calculation of time in mode will be obtained from aircraft specifications and from pilot surveys. The specific parameters used in this calculation are aircraft deceleration, descent angle, aircraft landing speed, and cruise speed. All of these are treated individually in subsequent paragraphs.

b. Location

This will be specified by the wind direction (which in turn will specify the runway to be used). The specific location will be at the end of the runway (obtained from the base map).

c. Emission Factor

The emission factor for each power setting will be given in terms of pounds of pollutant per 1000 pounds of fuel. These values are presented in table 8.

d. Fuel Flow Rate

The fuel flow rate in terms of 1000 lb/hr for each engine and mode. These values are also presented in table 8.

e. Descent Angle

The descent angle will be obtained from a survey of the pilots and base operations personnel (specifically control tower personnel).

f. Aircraft Landing Speed

Values for the landing speed of the 33 aircraft types will be obtained from design specifications and from information gained by the pilot survey.

g. Cruise Speed

This data will be obtained from aircraft specifications and pilot survey.

6. LANDING ON RUNWAY MODE

a. Time in Mode

The data necessary for calculation of time in mode will be obtained from aircraft specifications and from pilot surveys. The specific parameters used in this calculation are aircraft deceleration, aircraft landing speed, and taxi speed. All of these are treated individually in subsequent paragraphs.

b. Location

This will be specified by the wind direction (which in turn will specify the runway to be used). The specific location will be at the end of the runway (obtained from the base map).

c. Emission Factor

The emission factor for each power setting will be given in terms of pounds of pollutant per 1000 pounds of fuel. These values are presented in table 8.

d. Fuel Flow Rate

The fuel flow rate in terms of 1000 lb/hr for each engine and mode. These values are also presented in table 8.

e. Aircraft Landing Speed

Values for the landing speed of the 33 aircraft types will be obtained from design specifications and from information gained by the pilot survey.

f. Runway Landing Length

The length of runway used in landing by each of the 33 aircraft types will be obtained from aircraft specifications, pilot survey, and base operations personnel.

g. Taxi Speed in Miles Per Hour

This value will be obtained from a survey of pilots and personnel who are familiar with aircraft operations.

7. TAXI AFTER LANDING MODE

a. Time in Mode

The time in mode is dependent on the taxi length and speed.

b. Location and Length of Taxiway

The length and location of each taxiway will be specified by a set or sets of x, y coordinates obtained from a base map after consultation with personnel who are familiar with aircraft operations.

c. Emission Factors

The emission factor for each power setting will be given in terms of pounds of pollutant per 1000 pounds of fuel. These emission factors are presented in table 8.

d. Fuel Flow Rate

The fuel flow rate in terms of 1000 lb/hr for each engine and mode. These values are also presented in table 11.

e. Wind Direction

The values for wind direction will be obtained from ETAC. The wind direction will be used to designate the taxiway to be used in getting to the originating point from the runway that was used for landings. The landings runway is specified as the runway that has the major wind component in a direction so that the aircraft will land into the wind.

f. Taxi Speed in Miles Per Hour

This value will be obtained from a survey of pilots and personnel who are familiar with aircraft operations.

8. IDLE AT SHUTDOWN MODE

a. Time in Mode

The time for this mode will be a constant for each of the 33 aircraft types that will be considered. The numerical value for this operational parameter will be obtained from a survey of pilots who fly each aircraft type. The time factor will appear in the algorithm used to calculate the emission rate for this mode of the LTO cycle.

b. Location

The location for this mode will be an x, y coordinate value for each aircraft type. This data will be obtained from the base map and from a survey of base personnel associated with aircraft operations.

c. Emission Factor

The emission factor for each power setting will be given in terms of pounds of pollutant per 1000 pounds of fuel. These values are presented in table 8.

d. Fuel Flow Rate

The fuel flow rate in terms of 1000 lb/hr for each engine and mode. These values are also presented in table 8.

9. TOUCH-AND-GO MODE

All data for the touch-and-go operation can be obtained from information obtained for the other nine modes of the regular LTO cycle. Specific information will be obtained if operational procedures are considerably different

for this type of operation, but this can only be determined after some pilot surveys have been completed.

APPENDIX B

MOTOR VEHICLE CODE USED BY BASE TRANSPORTATION

This appendix contains copies of the motor vehicle code that is used as an identifier on the computer printout sheets. These pages were taken from AFM 300-4, Volume VII.

>1. Title: Vehicle Charge Designator, ADE VE-285, Chg Eff: 1 Jun 1972.
2. Data Name: VEH-CHRG-DSGNTR
3. Definition/Explanation: These identifiers are used to charge material costs to either operations, maintenance or exempt costs within the motor vehicle activity.
4. Data Use Identifiers and Explanations:

	4a. Data Name	4b. Code Size and Class
Vehicle Charge Designator: See 3 above	VEH-CHRG-DSGNTR	1A

5.

Data Codes	Data Items and Explanations
O	Operation
M	Maintenance
> N	Exempt

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1. Title: Vehicle Loss, Reason for, ADE VE-305, Chg Eff: 1 Jun 1972 (Trfd from Vol III)
2. Data Name: VEH-LOSS-RSN-FOR
3. Definition/Explanation: Indicates the reason for a vehicle being lost from the USAF/DoD inventory.
4. Data Use Identifiers and Explanation:

	4a. Data Name	4b. Code Size and Class
Vehicle Loss, Reason for: See 3 above	VEH-LOSS-RSN-FOR	1N

5.

Data Codes	Data Items and Explanations
1	Air Force Redistribution and Marketing Disposal
2	Other Services-Disposal by Other Services
3	Sold
4	Donation
5	Other
6	Date not Available
7	Deleted by Item Manager
9	Deleted by Base Equipment Manager Office (BEMO)

>1. Title: Vehicle Maintenance Identifier ADE VE-308, Chg Eff: 1 Jun 1972.
2. Data Name: VEH-MAINT-ID
3. Definition/Explanation: These identifiers are used to reflect deferred and contract maintenance backlog manhours.
4. Data Use Identifiers and Explanations:

	4a. Data Name	4b. Code Size and Class
Vehicle Maintenance Identifier: See 3 above	VEH-MAINT-ID	1A

5.

Data Codes	Data Items and Explanations
A	Personnel Not Available
B	Awaiting Approval/Disapproval of Repair Waiver Request
C	Parts on Order and the Vehicle Returned to the User
D	One time repair limit exceeded (Vehicle returned to user until replaced)
E	Vehicle Deadlined for Parts
F	Contract Maintenance
G	Skill Not Available
H	TCTO Awaiting Receipt of Kit
J	Facilities/Tools/Equipment Not Available
K	Military Priority (Vehicle Required for Mission)
L	Funds Not Available
M	Vehice Awaiting Investigation of Accident/Abuse
> N	Job Deleted No Action Required

1 Title Vehicle Management Codes (USAF and DoD), ADE VE-310, Chg Eff. 1 Jun 1972 (Trfd from Vol XII)
2 Data Name VHCLE-MGMT-CODES
3 Definition/Explanation These codes are used in the USAF Vehicle Management Reporting System. This system provides for the consolidation, computation and production of reports required by USAF and DoD.
4 Data Use Identifiers and Explanations:

	4a. Data Name	4b. Code Size and Class
USAF Vehicle Codes	USAF-VHCLE	4AN
DoD Vehicle Type	DOD-VHCLE-TYPE	4AN
DoD Vehicle Group	DOD-VHCLE-GROUP	1A

5 Data Codes — Data Items and Explanations

NOTE This four digit code system is based on the need for a management grouping of similar vehicles without detail stock number identification. The following principles apply (1) Vehicles are of two basic designs--Military or Commercial; (2) Vehicles have four basic applications--General Purpose, Special Purpose Construction and Base Maintenance, and Materials Handling, (3) Within each application area, vehicles are applied to specific uses, (4) Within each use are vehicles of similar characteristics but not uniformly identified by stock number. (5) Construction and Base Maintenance Equipment are basically of commercial design and will be reported as military design only in exceptional cases.

Example.

B 1 H — Design. Commercial
Application. General Purpose
Use. Bus
Characteristic. Bus, BOC, 20--37 Passenger

A DESIGN AND APPLICATION

B--Commercial, General Purpose
C--Commercial Special Purpose
D-Commercial, Construction and Base Maintenance Equipment
E--Materials Handling Equipment
K--Military, General Purpose
L--Military, Special Purpose
M--Military, Construction and Base Maintenance Equipment

B USE

For General and Special Purpose Vehicles.

1 Sedans, Buses Station Wagons, and Ambulances
2 Trucks
3 Truck Tractors and Aircraft Towing Tractors
4 Semitrailers
5 Dollies, Trailer Converter
6 Trailers
7 Carriers
8 Armored Vehicles
9 Not listed above

For Construction and Base Maintenance Equipment

1 Cranes
2 Tractors
3 Snow Removal Equipment
4 Sweepers
5 Miscellaneous (See detailed management codes)
6 Miscellaneous (See detailed management codes)
9 Not listed above

For Materials Handling Equipment:

1 Tractors, Warehouse
2 Trucks, Forklift and Side Loader
3 Trucks, Straddle Carry
4 Trucks, Fixed and Movable Platform
5 Cranes, Warehouse
6 Conveyors
7 463L Equipment
9 Not listed above

1 Title Vehicle Management Codes (USAF and DoD), ADE VE-310 Chg Eff: 1 Jun 1972 (Continued)
5. Data Codes Data Items and Explanations

C CHARACTERISTICS

01 through 98 specifies vehicles by size, weight, capacity, etc. A double or triple '9' in the numeric position is used to indicate vehicle(s) which cannot be identified by a specific code. For example:
B499 Semitrailer, Other
B999 Other General Purpose Commercial Design Vehicles

D LISTING OF EACH CODE

a. General Purpose: B--Commercial Design, K--Military DesIGN. (1) Precede the USAF Code with the applicable alpha. For example: A commercial design Lowbed Semitrailer would have USAF Code B400 a Military design Lowbed Semi-trailer would have USAF K400. (2) DoD group for military design (K) vehicles does not apply. (3) The alpha in the registration number and the alpha in the USAF Code must agree.

USAF Code	B DoD Type	K DoD Type	B DoD Group	Nomenclature
-101	1A	58A	A	Sedan, Compact
-102	1B	58B	A	Sedan, Light
-103	1C	58C	A	Sedan, Medium
-104	1D	58D	A	Sedan, Heavy
-110	2A	59A	B	Bus, BOC, 19 Passenger or Less
-110	2B	59B	B	Bus, BOC, 20-37 Passenger
-112	2C	59C	C	Bus, BOC, 38 Passenger and Over
-115	2D	59D	Q	Bus, Convertible to Ambulance
-120	2E	59E	D	Bus, Integral
-121	2EA	59EA	D	Bus, Integral, 41 Passenger DED (AFA and HQCOMD Only)
-125	2F	59F	Q	Bus, Multi-Train (4 Units)
-130	3	60	E	Station Wagon
-140	4A	61A	F	Ambulance, Truck
-141	4B	61B	F	Ambulance, Metropolitan
-142	4C	61C	F	Ambulance, Station Wagon
-200	5AA	62AA	H	Truck, Panel, 4x2 3,800-6 999 GVW
-201	5AB	62AB	I	Truck, Panel, 4x2, 7 000-10,000 GVW
-204	5AC	62AC	H	Truck, Panel, 4x4, 3,800-6,999 GVW
-205	5AD	62AD	I	Truck Panel, 4x4, 7,000-10,000 GVW
-208	5BA	62BA	I	Truck, Multistop, 4x2, 6,000-9,999 GVW
-209	5BB	62BB	J	Truck, Multistop, 4x2, 10,000-15,000 GVW
-212	5BC	62BC	I	Truck, Multistop, 4x4, 6,000-9,999 GVW
-213	5BD	62BD	J	Truck, Multistop, 4x4, 10,000-15,000 GVW
-216	5CA	62CA	H	Truck, Carryall, 4x2, 3,800-7,000 GVW
-219	5CB	62CB	H	Truck, Carryall, 4x4, 3,800-7,000 GVW
-222	5DA	62DA	H	Truck, Jeep, 4x2, 3,200-4,500 GVW
-225	5DB	62DB	H	Truck, Jeep, 4x4, 3,500-4,500 GVW
-228	5EA	62EA	H	Truck, PickUP, Compact, 4x2, 3,500-4,700 GVW
-231	5EB	62EB	H	Truck, Pickup, Compact, 4x4 3,500-4 700 GVW
-234	5EC	62EC	G	Truck, Pickup, 4 Door Cab, 4x2 4,800-5,799 GVW
-235	5ED	62ED	G	Truck, Pickup, 4 Door Cab, 4x2, 5,800-6,999 GVW
-238	5EE	62EE	G	Truck, Pickup, 4 Door Cab 4x4, 4,800-5 799 GVW
-239	5EF	62EF	G	Truck, Pickup, 4 Door Cab, 4x4, 5,800-6,999 GVW
-240	5EK	62EK	I	Truck, Pickup, 4 Door Cab, 4x4, 7,000-12,499 GVW
-242	5EG	52EG	G	Truck, Pickup, 4x2, 3,800-6 900 GVW
-243	5EH	62EH	I	Truck, Pickup, 4x2, 7,000-9,999 GVW
-246	5EI	62EI	G	Truck, Pickup, 4x4 3,800-6,999 GVW
-247	5EJ	62EJ	I	Truck, Pickup, 4x4, 7,000-9,999 GVW
-250	5FA	62FA	H	Truck, Stake and Platform, 4x2, 6,000-6,999 GVW
-251	5FB	62FB	I	Truck, Stake and Platform, 4x2, 7,000-9,999 GVW
-252	5FC	62FC	J	Truck, Stake and Platform, 4x2, 10,000-16,000 GVW
-255	5FD	62FD	H	Truck, Stake and Platform, 4x4, 6,000-6,999 GVW
-256	5FE	62FE	I	Truck, Stake and Platform, 4x4, 7,000-9,999 GVW
-257	5FF	62FF	J	Truck, Stake and Platform, 4x4, 10,000-16,000 GVW

1 Title: Vehicle Management Codes (USAF and DoD), ADE VE-310, Chg Eff: 1 Jun 1972 (Continued)
5 Data Codes

USAF Code	B DoD Type	K DoD Type	B DoD Group	Nomenclature
-260	5G	62G	J	Truck, 10,000-16,999 GVW
-261	5H	62H	K	TTruck, 17,000-20,999 GVW
-262	5I	62I	L	Truck, 21,000-23,999 GVW
-263	5J	62J	M	Truck, 24,000-44,500 GVW
-264	5K	62K	N	Truck, 44,501 GVW and Over
-270	5QA	62QA		Truck, Chassis 20,000-25,999 GVW
-271	5QB	62QB		Truck, Chassis 26,000-31,999 GVW
-272	5QC	62QC		Truck, Chassis 32,000-37,999 GVW
-273	5QD	62QD		Truck, Chassis 38,000 GVW and Over
-275	5R	62R		Truck, Utility Platform
-299	5Z	62Z		Truck, Other
-300	6A	63A	K	Truck, Tractor, 17,000-20,999 GVW
-301	6B	63B	L	Truck, Tractor, 21,000-23,999 GVW
-302	6C	63C	M	Truck, Tractor, 24,000-44,500 GVW
-303	6D	63D	N	Truck, Tractor, 44,501 GVW and Over
-399	6Z	63Z		Truck, Tractor, Other
-400	7A	64A		Semitrailer, Lowbed
-405	7B	64B		Semitrailer, Stake
-410	7C	64C		Semitrailer, Flatbed
-415	7D	64D		Semitrailer, Van
-499	7Z	64Z		Semitrailer, Other
-500	8	65		Dolly, Trailer Converter
-600	9A	66A		Trailer, Stake
-605	9B	66B		Trailer, Flatbed
-610	9C	66C		Trailer, Van
-615	9D	66D		Trailer, Tilt Deck
-620	9E	66E		Trailer, Cargo
-699	9Z	66Z		Trailer, Other
-999	10	67		Other General Purpose Vehicles Not Listed Above

b. Special Purpose: C--Commercial Design, L--Military Design. (1) Precede the USAF Code with the applicable alpha. For example: A commercial design Truck Wrecker would have USAF Code C201. A military design Truck wrecker would have USAF Code L201. (2) NOTE: The alpha in the registration number and the alpha in the USAF Code must agree.

-201	11A	68A		Truck, Wrecker
-205	11B	68B		Truck, Tractor, Wrecker
-210	12AA	69AA		Truck, Fire Pumper, 500
-211	12AB	69AB		Truck, Fire Pumper, 530, 530A, 530B
-212	12AC	69AC		Truck, Fire Pumper, 750A
-213	12AD	69AD		Truck, Fire Pumper, P8
-214	12AE	69AE		Truck, Fire Pumper, P-12
-220	12BA	69BA		Truck, Fire Crash, 06
-221	12BB	69BB		Truck, Fire Crash, 010
-222	12BC	69BC		Truck, Fire Crash, 011A, 011B
-223	12BD	69BD		Truck, Fire Crash, P2
-224	12BE	69BE		Truck, Fire Crash, P4
-225	12BF	69BF		Truck, Fire Crash, P6
-226	12BG	69BG		Truck, Fire Crash, R2, R2A
-227	12BH	69BH		Truck, Fire Crash, P10
-228	12BJ	69BJ		Truck, Fire Crash, P-13
-235	12D	69D		Truck, Powerline and Telephone
-236	12DA	69DA		Truck, Telephone Maintenance (P/U with special body)
-237	12E	69E		Truck, Refuse LODAL

1 Title Vehicle Management Codes (USAF and DoD), ADE VE-310, Chg Eff. 1 Jun 1972 (Continued)

5 Data Codes

USAF Code	B DoD Type	K DoD Type	Nomenclature
-238	12EA	69EA	Truck, Refuse, Load Packer
-239	12EB	69EB	Truck, Refuse, Container Hoisting
-240	12F	69F	Truck, Flatbed
-243	12G	69G	Truck, Van
-246	12H	69H	Truck, Insulator Washing
-249	12I	69I	Truck, Airfield Line Serving
-252	12JA	69JA	Truck, High Reach, 30-59 Feet
-253	12JB	69JB	Truck, High Reach, 60-74 Feet
-254	12JC	69JC	Truck, High Reach, 75-89 Feet
-255	12JD	69JD	Truck, High Reach, 90 Feet and Over
-258	12KA	69KA	Truck, High Lift, 10,000-19,999#
-259	12KB	69KB	Truck, High Lift, 20,000-29,999#
-260	12KC	69KC	Truck, High Lift, 30,000-39 000#
-261	12KD	69KD	Truck, High Lift, 40,000-49,000#
-262	12KE	69KE	Truck, High Lift, 50,000# and Over
-265	12LA	69LA	Truck, Fuel, 750-1,199 Gallons
-266	12LB	69LB	Truck, Fuel, 1,200-4,999 Gallons
-267	12LC	69LC	Truck, Fuel Servicing, 5000 Gallons, R-2
-268	12LD	69LD	Truck, Fuel Servicing, 5000 Gallons, R-5
-269	12LE	69LE	Truck, Fuel Servicing, 5000 Gallons, R-9
-270	12M	69M	Truck, Water, Potable
-271	12N	69N	Truck, Water, Waste
-272	12O	69O	Truck, Water, Demineralized
-275	12P	69P	Truck, Coal
-278	12Q	69Q	Truck, Refrigerator
-280	12R	69R	Truck, Liquid Nitrogen
-285	12VA	69VA	Truck, Dump 14,000-23,999 GVW
-286	12VB	69VB	Truck, Dump 24,000-32,999 GVW
-287	12VC	69VC	Truck, Dump 33,000-42,999 GVW
-288	12VD	69VD	Truck, Dump 43,000-59,999 GVW
-289	12VE	69VE	Truck, Dump 60,000 GVW and Over
-299	12Z	69Z	Truck, Other Special Purpose
-300	13	70	Tractor, Aircraft Towing MB-2
-301	13A	70A	Tractor, Aircraft Towing MB-4
-302	13B	70B	Tractor, Aircraft Towing U-18
-303	13C	70C	Tractor, Aircraft Towing U-30
-399	13Z	70Z	Tractor, Other Special Purpose
-400	14AA	71AA	Semitrailer, Fuel, 750-1,1999 Gallons
-401	14AB	71AB	Semitrailer, Fuel, 1,200-4,999 Gallons
-402	14AC	71AC	Semitrailer, Fuel, 5000 Gallons and Over
-410	14B	71B	Semitrailer, Acid
-415	14CA	71CA	Semitrailer, Water/Alcohol
-416	14CB	71CB	Semitrailer, Water, Potable
-420	14DA	71DA	Semitrailer, Nitrogen Tetroxide
-421	14DB	71DB	Semitrailer, UDMH
-425	14E	71E	Semitrailer, Compressed Gas
-430	14F	71F	Semitrailer, Liquid Oxygen
-450	14GA	71GA	Semitrailer, Van, Refrigerator
-460	14GZ	71GZ	Semitrailer, Van, Other
-470	14H	71H	Semitrailer, Runway Foaming
-499	14Z	71Z	Semitrailer, Other Special Purpose

1 Title Vehicle Management Codes (USAF and DoD), ADE VE-310, Chg Eff: 1 Jun 1972 (Continued)
5 Data Codes

USAF Code	B DoD Type	K DoD Type	Nomenclature
-600	15A	72A	Trailer, Fire Crash, 1029
-610	15C	72C	Trailer, Stake
-615	15D	72D	Trailer, Cable Reel and Splicer
-620	15E	72E	Trailer, PerSONNEL
-625	15F	72F	Trailer, Flatbed
-630	15GA	72GA	Trailer, Water/Alcohol
-631	15GB	72GB	Trailer, Water, Potable
-635	15H	72H	Trailer, Nitrogen
-640	15I	72I	Trailer, Oxygen
-645	15J	72J	Trailer, Compressed Gas
-650	15K	72K	Trailer, Fuel
-651	15KA	72KA	Trailer, Fuel Servicing A18
-655	15L	72L	Trailer, Van
-660	15M	72M	Trailer, Power Unit
-665	15N	72N	Trailer, Chassis
-670	15O	72O	Trailer, Bolster
-699	15Z	72Z	Trailer, Other Special Purpose
-700	16A	73A	Carrier, Cargo
-701	16B	73B	Carrier, Personnel
-702	16C	73C	Carrier, Amphibious
-705	16F	73F	Crane, H-11
-706	16G	73G	Crane, MC-1
-707	16H	73H	Crane, A-16
-708	16I	73I	Crane, Cole
-712	16M	73M	Dolly, Set
-713	16N	73N	Dolly Front
-730	16O	73O	Dolly, Rear
-800	17A	74A	Armored Car
-801	17B	74B	Armored Truck
-999	18	75	Other Special Purpose Vehicles Not Listed Above

c Construction and Base Maintenance Equipment: D--Commercial Design, M--Military Design. (1) Precede the USAF Code with the applicable alpha. For example: A commercial design Water Distributor would have USAF Code D621. A military design water Distributor would have USAF Code M621. (2) NOTE: The alpha in the registration number and the alpha in the USAF Code must agree.

-101	19A	76A	Crane, Towed
-102	19BA	76BA	Crane, Self Propelled, Truck Mounted
-103	19BB	76BB	Crane, Selp Propelled, Tractor Mounted
-209	20A	77A	Tractor, Wheeled (Age Towing)
-210	20AA	77AA	Tractor, Wheeled, Industrial and Agricultural
-211	20AB	77AB	Tractor, Wheeled, Bulldozer
-212	20BA	77BA	Tractor, Tracked, Size 1-3
-213	20BB	77BB	Tractor, Tracked, Size 4
-214	20BC	77BC	Tractor, Tracked, Size 5 and Over
-320	21AA	78AA	Snow Removal Unit, Bank Rotary, 34,000 GVW
-321	21AB	78AB	Snow Removal Unit, Bank Rotary, 54,000 GVW
-325	21BA	78BA	Snowplow, Displacement, 30,000-49,999 GVW
-326	21BB	78BB	Snowplow, Displacement, 50,000 GVW and Over
-440	22AA	79AA	Sweeper, Vacuum, M-3
-441	22AB	79AB	Sweeper, Vacuum, MC-1
-442	22AC	79AC	Sweeper, Vacuum, Other
-443	22B	79B	Sweeper, Magnetic

1. Title: Vehicle Managment Codes (USAF and DoD), ADE VE-310, Chg Eff: 1 Jun 1972 (Continued)
5. Data Codes

USAF Code	D DoD Type	M DoC Type	Nomenclature
-445	22C	79C	Sweeper, Rotary, Towed
-446	22D	79D	Sweeper, Rotary, Self Propelled
-447	22E	79E	Sweeper, Warehouse
-448	22F	79F	Sweeper, Snow Air Blast
-530	23A	80A	Loader, Tracked
-531	23B	80B	Loader, Pneumatic Tire
-532	23C	80C	Loader, Aggregate
-533	23D	80D	Loader, Belt
-550	24A	81A	Road Grader
-551	24BA	81BA	Road Scraper, Towed
-552	24BB	81BB	Road Scraper, Self Propelled
-553	24CA	81CA	Road Roller, Steel Wheel
-554	24CB	81CB	Road Roller, Self Propelled, Pneumatic Tire
-555	24CC	81CC	Road Roller, Towed
-556	24D	81D	Road Rooter
-606	25AA	82AA	Mixer, Concrete, Truck Mounted
-607	25AB	82AB	Mixer, Concrete, Trailer Mounted
-608	25B	82B	Mixer, Rotary Tiller
-609	25C	82C	Mixer, Bituminous
-611	26	83	Crushing/Screening Plant
-615	27	84	TrenchER
-618	28	85	Excavator
-620	29A	86A	Distributor, Bituminous
-621	29B	86B	Distributor, Water
-625	30C	87C	Truck, Dump, 33,000-42,999 GVW
-626	30D	87D	Truck, Dump, 43,000-59,999 GVW
-627	30E	87E	Truck, Dump, 60,000 and Over
-628	31	88	Trailer, Dump
-630	32	89	Kettle, Bituminous Heating
-632	33	90	Batching Plant
-633	33A	90A	Heater, Bituminous
-634	34	91	Earth Auger
-635	34	91A	Well Drilling Machine
-636	35	92	Compactor
-638	36	93	Drier
-640	37	94	Ditching Machine
-642	38	95	Digger Strainer
-644	39	96	Drill Rock
-646	40	97	Grouting Machine
-648	41	98	Joint Cleaning Refacing Unit
-650	42	99	Joint Sealing Unit
-652	43	100	Paving Machine
-654	44	101	Plow Cable
-656	45	102	Scrubbing Machine
-658	46	103	Marker, Airfield, Truck Mounted
-999	47	104	Other Construction and Base Maintenance Equipment Not Listed Above

d. Materials Handling Equipment - E. The alpha in the registration number and the alpha in the USAF must agree.

E101	48AA		Tractor, Warehouse, Gas, 1,000-3,999#
E102	48AB		Tractor, Warehouse, Gas, 4,000-6,999#
E103	48AC		Tractor, Warehouse, Gas, 7,000-9,999#
E104	48AD		Tractor, Warehouse, Gas, 10,000# and Over
E110	48BA		Tractor, Warehouse, Electric, 500-1,999#
E111	48BB		Tractor, Warehouse, Electric, 2,000-3,999#
E112	48BC		Tractor, Warehouse, Electric, 4,000# and Over
E200	49A		Truck, Forklift, Diesel, 6,000#
E210	49B		Truck, Forklift, Stock Selector, 3,000#

1. Title Vehicle Management Codes (USAF and DoD), ADE VE-310, Chg Eff: 1 Jun 1972 (Continued)
5. Data Codes

USAF Code	DOD Type	Nomenclature
E220	49CA	Truck, Forklift, Gas, 2,000-5,999#
E221	49CB	Truck, Forklift, Gas, 6,000-9,999#
E222	49CC	Truck, Forklift, Gas, 10,000-13,999#
E223	49CD	Truck, Forklift, Gas, 14,000-17,999#
E224	49CE	Truck, Forklift, Gas, 18,000-21,999#
E225	49CF	Truck, Forklift, Gas, 22,000# and Over
E230	49DA	Truck, Forklift, Electric, 2,000-3,999#
E231	49DB	Truck, Forklift, Electric, 4,000-5,999#
E232	49DC	Truck, Forklift, Electric, 6,000# and Over
E240	50	Truck, Side Loader
E300	51A	Truck, Straddle Carry, 30,000#
E305	51B	Truck, Straddle Carry, 50,000#
E400	52A	Truck, Fixed Platform, Gas
E410	52B	Truck, Fixed Flatform, Electric
E420	53A	Truck, Movable Platform, 1,000-4,999#
E421	53B	Truck, Movable Platform 5,000-9,999#
E422	53C	Truck, Movable Platform, 10,000-14,999#
E423	53D	Truck, Movable Platform, 15,000# and Over
E430	53K	Truck, Stake, Airfield, Fixed Platform
E435	53L	Truck, Stake Airfield, Elevating Platform
E440	53M	Truck, Stake, Pallet Electric 4000#
E500	54AA	Crane, Warehouse, Gas, 6,000-9,999#
E502	54AB	Crane, Warehouse, Gas, 10,000-19,999#
E503	54AC	Crane, Warehouse, Gas, 20,000# and Over
E510	54BA	Crane, Warehouse, Electric, 3,000-5,999#
E511	54BB	Crane, Warehouse, Electric, 6,000-9,999#
E512	54BC	Crane, Warehouse, Electric, 10,000# and Over
E600	55A	Conveyor, Drag
E605	55B	Conveyor, Belt
E610	55C	Conveyor, Aggregate
E700	56A	Truck (CONDEC) A/S32H-5, 25K (463L)
E705	56B	Truck (Koehring) A/S32H-6, 40K (463L)
E710	56C	Truck (Koehring) A/S32H-16, 55K (463L)
E715	56D	Truck, Tracked, Rough Terrain (Food Machinery), A/S32H-12, 10K (463L)
E716	56DA	Truck, Forklift (Clark) GED 4,000# PT Low Mast (463L)
E720	56E	Truck, Forklift (Hyster) A/S 32H-7, 6K (463L)
E725	56F	Truck, Forklift (Clark) A/S32H-7, 6K (463L)
E730	56G	Truck, Forklift (Hyster) A/S32H-10, 10K (463L)
E735	56H	Truck, Forklift (Silent Hoist) A/S32H-10, 10K (463L)
E740	56I	Truck, Forklift (Clark) Rough Terrain A/S32H-13, 6K (463L)
E745	56J	Truck, Forklift, Rough Terrain (Hyster) P100A-48-AF, 10K (463L)
E750	56K	Truck, Forklift, Adverse Terrain (Euclid) A/S32H-15, 10K (463L)
E755	56L	Trailer, Loader (Air Logistics) A/M32H-4 10K (463L)
E760	56M	Tractor, Warehouse Electric 1200# (Moto Truck) (463L)
E999	57	Other Materials Handling Equipment Not Listed Above.

e. Agricultural Equipment.

1010		Lawn Mower, Self-Propelled, Gang Reel Type
1040		Lawn Mover, Rotary, Riding Type, Up To 60'
1045		Lawn Mower, Rotary, Riding Type, Over 60'
1050		Lawn Mower, Rotary, Tractor Riding Type
1099		Grass Cutters, All Other Engine Powered
1215		Edgers, Tractor Mounted
1230		Seed Drill, GED

1 Title Vehicle Management Codes (USAF and DoD). ADE VE-310. Ch Eff: 1 Jun 1972 (Continued)
5 Data Codes

USAF Code	Nomenclature
1240	Vertifier, Turf, GED
1250	Aerator, Turf, Self Propelled
1260	Renovator, Turf, GED
1299	Lawn Maintenance Equipment, All Other (Engine Powered)
1310	Harrow/Disc, All Types GED
1320	Tillers, All Types GED
1399	Ground Cultivating, All Other Engine Powered
1410	Garden Tractor,, Walking Type
1420	Garden Tractor, Riding
1999	Agricultural Equipment, All Other Engine Powered

f AGE/GSE

W201	Deicer Unit, Truck Mounted
W203	Truck, Lavatory Service
W204	Truck, Propeller Handling
W205	Truck, Staircase
W207	Wheel Drive Unit (B-52 Wheel Mover)
W208	Air Conditioner, Truck Mounted
W215	Servicing Platform, Truck Mounted
W221	Fuel Transfer Trailer, Hose Cart, MH-2/MH-2A
W222	Truck, Fuel Transfer, Hose Cart, R-4
7030	Tester, Prover Tank, Liquid
7210	Lawn Sweeper, All Type GED
7215	Pavement Sweeper, All Types
7232	Back Hoe
7236	Earth Auger, Skid or Tractor Mounted
7238	Mixer, Concrete
7250	Trench/Ditcher
7260	Stump Remover, GED
7810	Snow Plow, Displacement
7820	Snow Blower Attachment for Loaders
7830	Sander, Road and Airfield
7899	Snow Related Equipment, All Other
8210	Truck, Targeting Trainer
8220	Truck, Ground Elevator (Geodetic) Survey
8299	Miscellaneous Trucks, All Other
8310	Air Compressor, Truck Mounted
8410	Tractor, Loader, Self Propelled

>1 Title Vehicle Record Status Indicator, ADE VE-312, Chg Eff: 1 Jun 1972.
2 Data Name VEH-RECORD-STTS-INDCTR
3 Definition/Explanation These identifiers reflect the status of transactions.
4. Data Use Identifiers and Explanations:

	4a. Data Name	4b. Code Size and Class
Vehicle Record Status Indicator. See 3 above	VEH-RECORD-STTS-INDCTR	3A

5. Data Codes	Data Items and Explanations:
IRA	Input Record Accepted
IRE	Input Record Error
SRA	Suspense Record Accepted
SRN	Suspense Record New
> SRO	Suspense Record Old

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1 Title Vehicle Replacement Reason ADE VE-314, Chg Eff: 1 Jun 1972 (Trfd from Vol III)
>2. Data Name VEH-REPL-RSN
>3 Definition/Explanation: These identifiers reflect a vehicle's condition in respect to its eligibility for replace-
> ment. They reflect a vehicle's condition for AGE, MILEAGE, and ONE-TIME REPAIR STATUS.
4. Data Use Identifier and Explanation:

	4a. Data Name	4b. Code Size and Class
> Vehicle Replacement Reason. See 3 above	VEH-REPL-RSN	1A

5. Data Codes	Data Items and Explanations
A	Age, Miles and One Time Repair
B	Age and One Time Repair
C	Miles and One Time Repair
D	One Time Repair
> E	Reserved for Special Reporting
F	Obsolete
G	Age and Miles
H	Age
J	Miles
K	Age and Miles, One Year
L	Age, One Year
M	Miles, One Year
N	Age and Miles, Two Years
P	Age, Two Years
Q	Miles Two Years
> R	Assign in Accordance with T.O. 36A-1-70

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1 Title Vehicle Reporting Region, ADE VE-315, Chg Eff: 1 Jun 1972 (Trfd from Vol XII)
>2. Data Name: VEH-RPT-RGN
3. Definition/Explanation Identifies the geographical distribution of vehicles.
4. Data Use Identifiers and Explanation:

	4a. Data Name	4b. Code Size and Class
> Vehicle Reporting Region See 3 above	VEH-RPT-RGN	1N

5. Data Codes	Data Items and Explanations:
1	United States (including Alaska and Hawaii)
2	Overseas (includes all foreign Countries)
3	United States Possessions

APPENDIX C

BLANK FIELD DATA COLLECTION SHEETS
(Separate attachments distributed only
to field data collection agencies).